# FLOOD ASSESSMENT AND STORMWATER MANAGEMENT PLAN





# Sydney Metro City & Southwest: Crows Nest Over Station Development

Flood Assessment and Stormwater Management Plan

Applicable to:	Sydney Metro City & Southwest	
Author:	SMEC	
Owner	Sydney Metro Authority	
Status:	Final	
Version:	1	
Date of issue:	July 2020	
© Sydney Metro 2020		



### Document No: NWRLSRT-MET-SCN-CE-REP-000004

Revision	Date	Suitability Code
0	05/11/18	For Stage Approval
1	31/07/2020	For Stage Approval

### **Approval Record**

Function	Position	Name	Date
Prepared by	Drainage Engineer	S.Yamamoto & Pulith Vidanapathirana	31/07/2020
Technical Checker	Drainage Engineer	Pulith Vidanapathirana	31/07/2020
Reviewed By	Principal Environmental Engineer	Greg Tallentire	31/07/2020
Approved by	Engineering Manager	Willem Van Ede	31/07/2020

### **Amendment Record**

Changes made to this document since its last revision, which affect its scope or sense, are marked in the right margin by a vertical bar ( | ).

Date	Rev	Amendment Description	Ву
	A	Draft	
	В	Updated in response to Sydney Metro comments	
	0	Final draft	
	1	Final	

Information Class: Standard			
This document is issued for the party which commissioned it and for specific purposes connected with the above-captioned project only. It should not be relied upon by any other party or used for any other purpose.	We accept no responsibility of the consequences of this document being relied upon by any other party, or being used for any other purpose, or containing any error or omission which is due to an error or omission in data supplied to us by other parties.		
	This document contains confidential information and proprietary intellectual property. It should not be shown to other parties without consent from us and from the party which commissioned it.		



# **Table of Contents**

1.0	Introdu	luction		
	1.1	Purpose of this report		
	1.2	Changes	between the Exhibited Scheme and Amended Scheme	. 10
2.0 Scope of Assessment			ment	. 15
	2.1	Appendic	es	. 16
3.0	Releva	nt Standa	rds and Guidelines	. 18
	3.1	Australia	n Standards	. 18
	3.2	Guideline	9S	. 18
	3.3	RMS Spe	ecifications	. 18
	3.4	Council S	Standards	. 19
	3.5	Referenc	e Documents	. 19
4.0	Floodin	ng		. 20
	4.1	Received	Flood Model	. 20
	4.2	Hydrolog	ic Model Review	. 21
	4.3	Hydraulic	Model Review	. 23
	4.4	Modelling	g Results	. 24
		4.4.1	Flood Depth	24
		4.4.2	Flood Level Impacts	25
		4.4.3	Flood Velocity Impacts	28
		4.4.4	Changes to Inundation Time	28
	4.5	Flood Pla	anning Requirements	. 28
		4.5.1	Sydney Metro City and Southwest Design Criteria	29
		4.5.2	Other Entrances	32
	4.6	Climate C	Change Sensitivity	. 33
5.0	Stormw	ater Drai	nage Design	. 35
	5.1	Design O	bjectives	. 35
	5.2	Existing [	Drainage	. 35
	5.3	Existing S	Site Runoff	. 36
	5.4	Proposed	I Drainage Strategy	. 37
		5.4.1	Site A Drainage	37
		5.4.2	Site B Drainage	39
		5.4.3	Site C Drainage	39
		5.4.4	Detention Tanks and Downpipes	40
	5.5	Detentior	n Modelling	. 40
	5.6	Modelling	g Results	. 40
	5.7	Recomm	endations	. 41
		5.7.1	Final tank sizing	41
	5.8	Down Pip	be Coordination	. 42
6.0	Stormw	ater Qual	ity	. 43

© Sydney Metro 2020

Page 3 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -



	6.1	Water Quality Objectives		
	6.2	Modellin	ng Approach	
		6.2.1	MUSIC	
		6.2.2	Methodology	
	6.3	Model Ir	nputs	
	6.4	Propose	ed Treatment Devices	
		6.4.1	Treatment Measures within OSD Envelope .	
	6.5	Stormwa	ater Quality Modelling Results	
7.0	Conclu	sion		
Append	dix A			
	Flood M	lapping		
Append	dix B			50
	Propose	ed OSD C	Catchment Plan (Revised)	
Append	dix C			
	Crows I	Nest DRA	INS Data (Revised)	
Append	dix D			
	MUSIC	Data (Re	vised)	
Append	dix E	·····	·	53
	Update	d Corresp	oondence with North Sydney Council	



# **Terms & Definitions**

	Definition
ARI	Average Recurrence Interval – The "average" or expected value of the periods between exceedances of a given rainfall total accumulated over a given duration. It is implicit in this definition that the periods between exceedances are generally random.
Amended OSD Scheme	Revised OSD design from the original SSDA scheme
BMS	Means the Building Management Statement prepared by TfNSW and which outlines the mechanism for managing the operational interfaces between the OSD Lot(s) and the Station Lot(s)
BOD	Means the Basis of Design Report undertaken by USDTS Design team to provide summary of basic design criteria and design requirements.
CSSI	An application made for the development of the Sydney Metro under the Critical State Significant Infrastructure provisions of the EP&A Act 1979 (as amended)
CNDC	Crows Nest Design Consortium responsible for development of Stages 2 and 3 Detailed Design for Crows Nest Station.
DRAINS	Stormwater Drainage System design and analysis program.
Integrated OSD Design	Means the design concept prepared by the OSD Design team which integrates a commercially viable OSD with the Metro Station
Metro Station	Means the functional areas necessary for the efficient and effective use and operation of the Sydney metro at the location the subject of this document
Exhibited OSD Scheme	OSD design as per SSDA application prepared by Metron in Stage 1
OSD	Means the development of air space over each site acquired to enable the Sydney Metro project; also known as Over Station Development where the site is a Station
OSD Developer	Means the entity awarded the rights to commercially develop the OSD Lot(s).
OSD Enabling Works	Means the works to be provided by the STME and TSE Contractors and designed by the CNDC Design Team to fully enable the subsequent development of the OSD
OSD Lot(s)	Means the spaces created by volumetric title that accommodates the functional areas necessary for the efficient and effective use and operation of the OSD. The OSD Lot(s) may be further subdivided to create lots specific to different uses
PMF	Probable Maximum Flood, the flood resulting from Probable Maximum Precipitation.

Page 5 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -



	Definition
Pre-Existing Site	The previously existing site, prior to any demolition or diversion works undertaken for the Sydney Metro Station.
PSD	Permissible Site Discharge of stormwater runoff stipulated by Council.
Reference Design	The scope of the Project as determined by the NSW Government as a result of the Project Definition Phase. The Reference Design consists of the Reference Scope and technical requirements prior to the Stage 1 Design.
SSD	An application made for the development of the OSD under the State Significant Development provisions of the EP&A Act 1979 (as amended)
Stage 1 Design	The scope of the Project as determined by the NSW Government as a result of the Project Reference Design Phase. The Stage 1 Preliminary 40% Design phase follows on from the Reference Design.
Station Lot(s)	Means the spaces created by volumetric title that accommodates the functional areas necessary for the efficient and effective use and operation of the Metro Station
STME Contract	Means the Stations, Mechanical and Electrical Works undertaken by the STME Contractor
STME Contractor	Means the contractor appointed under the STME Contract
Sydney Metro (Metro)	Means the overall Sydney Metro network
SMDO	Means the Sydney Metro Delivery Office set up by TfNSW
Sydney Metro Northwest	Means the former North West Rail Link, i.e. the project between Cudgegong Road, Rouse Hill and Chatswood (inclusive)
Sydney Metro City & Southwest	Means the proposed metro railway between Chatswood and Bankstown, including the Sydney Metro Harbour Crossing.
Sydney Trains	An organisation formed out of RailCorp from the NSW rail industry reform process. Sydney Trains serves Sydney customers. NSW Trains serves intercity and regional customers.
TfNSW	Means Transport for NSW (a New South Wales government agency constituted under the Transport Administration Act 1988 (NSW)) (ABN 18 804 239 602), the Principal under this Agreement.
Transfer Level	Means the uppermost level to be constructed by the STME Contractor and at which level design responsibility for the performance of the OSD transfers from the OSD Design team to the CNDC Design team
TUFLOW	(Two-dimensional Unsteady FLOW) is a two-dimensional (2D) and one dimensional (1D) flood and tide simulation software. It simulates the hydrodynamics of water bodies using 2D and 1D free-surface flow equations.
TSE Contractor	Means the contractor appointed to undertake the TSE Works

© Sydney Metro 2020

Page 6 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -



	Definition
TSE Works	Means the design and construct contract for the tunnels, station excavations, cross passages and associated civil works components of the Sydney Metro City and Southwest
Works	Means the works to be performed by a major works contractor under a Project Deed.



### **Executive Summary**

This report supports a concept State Significant Development Application submitted to the Department of Planning and Environment for the Over Station Development (OSD) at Crows Nest Metro Station.

The OSD concept drawings were prepared by Sydney Metro for the OSD at Crows Nest in support of the concept SSD Application and in response to the Secretary's Environmental Assessment Requirements (SEARs) issued for the project on 26 September 2018. The OSD scheme submitted in November 2018 for public exhibition has been amended in the following manner:

- Site A land-use changed to Commercial
- Site B land-use changed to Residential
- Reduction in the envelope of Site A from two separate towers to a single stepped tower
  form
- Gross floor area (GFA) allocations revised for all three sites.

This report specifically outlines amendments to the flooding and stormwater strategy for the OSD concept drawings since the Crows Nest OSD concept SSD Application was on public exhibition.

The Crows Nest Station precinct is located between the Pacific Highway and Clarke Street (eastern side of the Pacific Highway) and Oxley Street and south of Hume Street, Crows Nest. The Over Station Development is primarily situated above the Sydney Metro station and separated in to 3 separate areas, Site A, B and C.

The Crows Nest Station site is susceptible to 100-year ARI and PMF flooding. Therefore, the proposed entrances servicing the OSD and Metro Station must be designed to prevent the ingress of floodwater.

Since public exhibition of the Crows Nest OSD concept SSD Application, the North Sydney LGA-Wide Flood Study model was made available to CNDC for the Stages 2 and 3 Detailed Design of Crows Nest station. The resolution of this model was increased and the revised building footprint, civil roadworks and proposed stormwater upgrades were modelled. The model was updated according to the more recently published Australian Rainfall and Runoff 2016 (AR&R2016) guidelines for flood estimation. The flood model was simulated for both the existing and post-development scenarios to define flood levels and velocities in the vicinity of Crows Nest Station. Flood protection levels for the revised OSD and station entrances were determined and a flood impact assessment has been undertaken to visualise flood level and velocity impacts caused by proposed works to ensure compliance with Sydney Metro - Chatswood to Sydenham SPIR REMM FH9. The impact of increased rainfall intensity due to climate change was assessed according to AR&R2016 procedures.

Based on the more detailed flood assessment, the recommended definition of flood protection put forth in the public exhibition version of Crows Nest OSD concept SSD Application has

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -

Appendix G: Flood Assessment and Stormwater Management Plan



been revised. The flood protection level was previously defined as the larger of the PMF flood level and 300 mm higher than the surveyed existing ground level for all entrances into the station, tunnel and OSD. This definition has been revised for the following reasons:

- Based on the CNDC Stage 2 Crows Nest station design, only one OSD egress stair is interconnected with the underground railway infrastructure. The rest of the OSD entrances either lead up to storeys above the ground floor or are not connected with the underground rail infrastructure and therefore do not require onerous flood protection
- Providing flood protection by setting entrances 300 mm above the surveyed existing ground level does not account for the possibility of the proposed Civil level at the entrance threshold being higher than the surveyed level. In this case, less than 300 mm freeboard would be achieved.

The new flood protection level requirement for entrances into underground rail infrastructure is to be defined as the larger of the PMF flood level and 300 mm higher than the surrounding finished ground level (i.e. proposed Civil level at the threshold) or sufficient to prevent local flash flooding entering the underground structures. For other entrances which do not lead to underground railway infrastructure, including a number of OSD entrances, the required flood protection level is the larger of the PMF flood level and the surrounding finished ground level (without freeboard).

As per the Exhibited OSD Scheme, the station design will make stormwater provisions for the future OSD development. The station designers must allow the OSD to be constructed after the station becomes operational with no impact on Metro operation. The physical provisions for drainage connections and infrastructure below the Transfer Level are planned to be undertaken as part of the station works under the CSSI Approval. This strategy is aimed at reducing the potential for future disruption to the Metro Station and surrounding areas should the OSD construction be delayed after the completion of the station.

The revised detention strategy for the Amended OSD Scheme proposes that all detention tanks are accommodated within the OSD buildings. The Exhibited OSD Scheme proposed an underground detention tank on Clarke Lane which has now been removed. Stormwater detention modelling has been undertaken to determine preliminary tank sizing requirements to meet North Sydney Council's Permissible Site Discharge requirements. These tanks will be located within each of the Over Station Buildings.

The removal of the podium deck and green roof at Site A in the Amended OSD Scheme has facilitated revisions to the water quality strategy. Green roof installations will likely be required for sections of roof area at Sites A, B and C. North Sydney Council has also advised CNDC of revised water quality improvement targets. These targets are to be achieved through a range of measures including the incorporation of roof gardens, rainwater harvesting tanksand other suitable treatment measures. In-ground proprietary units and litter baskets will be provided as part of the station works that will assist the water quality strategy for the OSD.



## **1.0 Introduction**

### **1.1 Purpose of this report**

This report supports the Response to Submissions Report (Submissions Report) for the concept State Significant Development application (concept SSD Application) submitted to the Department of Planning, Industry and Environment (DPIE) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The concept SSD Application is made under Section 4.22 of the EP&A Act.

Sydney Metro is seeking to secure concept approval for a mixed use development comprising three buildings above the Crows Nest Station, otherwise known as the over station development (OSD). The concept SSD Application seeks consent for building envelopes and land uses, maximum building heights, maximum gross floor areas, pedestrian and vehicular access, circulation arrangements and associated car parking and the strategies and design parameters for the future detailed design of the development.

The station and public domain elements form part of a separate planning approval for Critical State Significant Infrastructure (CSSI) approved by DPIE on 9 January 2017.

As the development is within a rail corridor, is associated with railway infrastructure and is for commercial premises and residential accommodation with a Capital Investment Value of more than \$30 million, the project is identified as State Significant Development (SSD) pursuant to Schedule 1, 19(2)(a) of the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP). The development is, therefore, State significant development for the purposes of Section 4.36 of the EP&A Act.

A Flood Assessment and Stormwater Management Plan Report (2018) was prepared as Appendix W of the Environmental Impact Statement for the concept SSD Application to specifically respond to the Secretary's Environmental Assessment Requirements (SEARs) issued on 26 September 2018. Following Exhibition of the Environmental Impact Statement, the design of the OSD has responded to issues raised in submissions. The purpose of this report is to identify those changes in the Amended OSD Scheme and to assess the impacts of changes with regards to flood impact and storm water management.

### **1.2 Changes between the Exhibited Scheme and Amended Scheme**

In response to the submissions made on the Exhibited Scheme, the following changes have been made to the concept SSD Application under what is termed the Amended Scheme:

- Changes to the building envelope
- Changes in proposed land use on each site
- Reduction in car parking numbers
- Inclusion of an articulation zone
- Clarification on the provision of social infrastructure

© Sydney Metro 2020

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -



• Amendments to the Design Guidelines.

These changes are described in further detail in Chapter 7 of the Submissions Report. The western elevation of the Amended Scheme is shown below, with a summary of the changes between the Exhibited Scheme and Amended Scheme provided in the table below.



**Figure 1-1** – West elevation of the building envelope under the Amended Scheme, showing CSSI Approval (pink) OSD components (blue) and articulation zone (hatched)

**Table 1-1** Changes to overall concept scheme per site under the Exhibited Scheme and Amended Scheme (excluding station GFA)

	Exhibited Scheme <sup>1</sup>	Amended Scheme <sup>1</sup>
Site A		
Land Use	Residential <sup>2</sup>	Commercial
GFA	37,500m <sup>2</sup>	40,207m <sup>2</sup>
Max height - top of roof (RL)	183	175.6
Max height - top of services zone (RL)	188	180
FSR - OSD	9.67:1	10.4:1
Non-residential FSR - OSD	0.7:1	10.4:1
Car parking	125	46

© Sydney Metro 2020

Page 11 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -

Appendix G: Flood Assessment and Stormwater Management Plan



	Exhibited Scheme <sup>1</sup>	Amended Scheme <sup>1</sup>
Site B		
Land Use	Tourist / visitor accommodation	Residential
Max height - top of roof (RL)	155	155
Max height - top of services zone (RL)	158	158
GFA	15,200m <sup>2</sup>	12,685m <sup>2</sup>
FSR - OSD	8.12:1	6.8:1
Non-residential FSR - OSD	8.12:1	0.1:1
Car parking	25	55
Site C		
Land Use	Commercial <sup>2</sup>	Commercial <sup>2</sup>
Max height – top of roof (RL)	127	127
Max height – top of services zone (RL)	132	132
GFA	2,700m <sup>2</sup>	3,031m <sup>2</sup>
FSR – OSD	4.44:1	4.9:1
Non-residential FSR - OSD	4.44:1	4.9:1
Car parking	0	0

<sup>1</sup> GFA figures exclude GFA attributable to the station and station retail space approved under the CSSI approval

<sup>2</sup> The Exhibited Scheme included a provisional option for social infrastructure GFA to be located on Site A or Site C inclusive of the GFA figures nominated above.

The revised concept SSD Application (SSD-9579) under the Amended Scheme seeks approval for the following:

- Maximum building envelopes for Sites A, B and C, including street wall heights and setbacks as illustrated in the plans prepared by Crows Nest Design Consortium for Sydney Metro at Appendix A to the Submissions Report
- Maximum building heights:
  - **Site A:** RL 175.60 metres or equivalent of 21 storeys (includes two station levels and conceptual OSD space in the podium approved under the CSSI Approval)
  - **Site B:** RL 155 metres or equivalent of 17 storeys (includes two station levels and conceptual OSD space approved under the CSSI Approval)
  - Site C: RL 127 metres or 9 storeys (includes two station levels and conceptual OSD space approved under the CSSI Approval).



**Note 1**: the maximum building heights defined above are measured to the top of the roof slab and exclude building parapets which will be resolved as part of future detailed SSD Application(s)

- Maximum height for a building services zone on top of each building to accommodate lift overruns, rooftop plant and services:
  - Site A: RL 180 or 4.4 metres
  - Site B: RL 158 or 3 metres
  - Site C: RL 132 or 5 metres.

Note 1: the use of the space within the building services zone is restricted to non-habitable floor space.

**Note 2**: for the purposes of the concept SSD Application, the maximum height of the building envelope does not make provision for the following items, which will be resolved as part of the future detailed SSD Application(s):

- Communication devices, antennae, satellite dishes, masts, flagpoles, chimneys, flues and the like, which are excluded from the calculation of building height pursuant to the standard definition in NSLEP 2013
- Architectural roof features, which are subject to compliance with the provisions in Clause 5.6 of NSLEP 2013, and may exceed the maximum building height, subject to development consent.
- Maximum gross floor area (GFA) of 56,400 square metres for the OSD comprising the following based on the proposed land uses:
  - Site A: Commercial office premises maximum 40,300 square metres
  - Site B: Residential accommodation maximum of 13,000 square metres
  - Site C: Commercial office premises maximum of 3,100 square metres.

**Note:** GFA figures exclude GFA attributed to the station and station retail space approved under the CSSI Approval

- minimum non-residential floor space for the OSD across combined Sites A, B and C of 43,505 square metres
- the use of conceptual areas associated with the OSD which have been provisioned for in the Crows Nest station box (CSSI Approval) including areas above ground level (i.e. OSD lobbies and associated spaces)
- a maximum of 101 car parking spaces on Sites A and B associated with the proposed commercial and residential uses
- modulation and expression of built forms within an articulation zone extending to the property boundary
- loading, vehicular and pedestrian access arrangements
- strategies for utilities and services provision
- strategies for managing stormwater and drainage



- a strategy for the achievement of ecological sustainable development
- a public art strategy
- indicative signage zones
- a design excellence framework
- the future subdivision of parts of the OSD footprint, if required.



## 2.0 Scope of Assessment

This report specifically outlines amendments to the flooding and stormwater strategy for the Amended OSD Scheme since the Crows Nest OSD concept SSD Application was on public exhibition in November 2018.

The assessment includes identification of the infrastructure required to service the amended OSD design, however the physical provisions for drainage connections and infrastructure below the Transfer Level are planned to be undertaken as part of the station works under the CSSI Approval. This strategy is aimed at reducing the potential for future disruption of footpath access should the OSD construction on Site A and Site B be delayed after the completion of the station and Site C.

The following tasks were also undertaken as part of this report:

- Review of relevant legislation, policies and guidelines associated with stormwater management
- Review of Local Government Authorities Regional Flood Studies
- Review of METRON Stage 1 Design
- Consultation with Sydney Metro's station design team in relation to flood modelling and mitigation and station stormwater design and management, (conducting Stage 2 Design)
- Identification of amendments to the OSD stormwater management strategy
- Amended estimation of OSD on-site detention volumes and configurations.

It is important to note that the stormwater management and flood mitigation measures within the proposed Crows Nest station leads the context for the assessment of flood impacts and stormwater management plans for the OSD.

Table 2-1 provides a summary of interfaces and responsibilities between the CSSI Approval and the concept SSD Application. Relevant references are made throughout this report to the preliminary design undertaken by Sydney Metro's station design team to provide context for the concept proposal and the indicative OSD design.



Item	Responsibility	Interface Details
Flood modelling	Sydney Metro are responsible for undertaking a flood assessment for the new station and public domain, under the terms of the CSSI Approval.	Detailed flood modelling has been undertaken by Sydney Metro in accordance with the CSSI Approval to assess the flooding impacts and inform flood protection levels of the proposed OSD. Outcomes and features of the detailed flood assessment are broadly discussed within this report
Stormwater management	Sydney Metro are responsible for providing a stormwater management plan for the station, station retail and public domain areas within the site area including in-ground stormwater asset modification/installation under the CSSI Approval. The concept SSD Application is responsible for stormwater management of the proposed OSD including rainwater collection, storage, treatment and discharge to in-ground infrastructure.	A stormwater management plan for the station design has been undertaken in accordance with the CSSI Approval and broadly discussed in this report. A Stormwater Management Plan for the OSD is detailed within this report adopting the design criteria identified through preliminary authority liaison as part of the CSSI Approval.
Authority liaison	Sydney Metro are responsible for undertaking authority liaison (Sydney water and North Sydney Council) for the development (Station and OSD).	Preliminary authority liaison with Sydney Water and Council has been undertaken by Sydney Metro with the principles and outcomes of the liaison discussed within this report.

#### Table 2-1 Summary of Interface Details and Responsibilities

### 2.1 Appendices

The Appendices from the Exhibited OSD Scheme (EIS Appendix W version P07 Dated November 2018) have been reviewed for suitability in the Amended OSD Scheme. Refer to Table 2-2.

Table 2-2 Summary of	Changes to	Appendices
----------------------	------------	------------

Original Appendix	Original Appendix Title	Comment
Appendix A	Sydney Metro – Crows Nest Reference Design Information	To be discontinued. Refer to Figure 4-4, Table 4-3 and Table 4-4 for updated information. The Reference Design information has been replaced by Stage 2 Design information.
Appendix B	Summary of the OSD Entrance Levels	To be discontinued. Refer to Table 4-4 for updated information.
Appendix C	Pre-Existing and Proposed Catchment Plan	Information superseded by Appendix B of this report
Appendix D	Pre-existing Drainage Infrastructure	Information still current and valid
Appendix E	Crows Nest DRAINS Data	Information superseded by Appendix C of this report
Appendix F	Over Station Development Rainwater Tank & Detention Tank Locations	Locations of rainwater tanks and detention tanks at Site A to be

© Sydney Metro 2020

Page 16 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -

Appendix G: Flood Assessment and Stormwater Management Plan



Original Appendix	Original Appendix Title	Comment
		determined by OSD Developer. Locations of rainwater tanks and detention tanks at Site B still current and valid.
Appendix G	Proposed Over Station Drainage Strategy	This Appendix has not been made available to review
Appendix H	Podium Level Green Roof Drainage Schematic	To be discontinued. Information no longer valid.
Appendix I	Typical On-Site Detention System for Site A, B and C	This Appendix has not been made available to review
Appendix J	MUSIC Data	Information superseded by Appendix D of this report
Appendix K	North Sydney Council Correspondence	Updated correspondence from Council included in Appendix E of this report



### 3.0 Relevant Standards and Guidelines

### 3.1 Australian Standards

- AS/NZS 1477 2006 PVC Pipes and Fitting for Pressure Application
- AS 1657 2013 Fixed platform, walkway, stairways, and ladders
- AS/NZS 2033 2008 Installation of Polyethylene Pipe Systems
- AS 2200 2006 Design Charts for Water Supply and Sewerage
- AS 2566.1 1998 Buried Flexible Pipelines Structural Design
- AS 2601 2001 The Demolition of Structures
- AS/NZS 2638 2011 Gate Valves for Waterworks Purposes
- AS 2941 2013 Fixed Pump set installations
- AS/NZS 3500 2015 Plumbing and Drainage
- AS 3725 2007 Design for Installation of Buried Concrete Pipes
- AS/NZS 4129 2008 Fittings for Polyethylene Pipes for Pressure Purposes
- AS/NZS 4130 2009 Polyethylene Pipes for Pressure Purposes
- AS 5200.000 2006 Plumbing and Drainage Products
- BCA 2016 Building Code of Australia
- WSA 01 2004 Water Supply Code of Australia
- WSA 02 2014 Gravity Sewerage Code of Australia
- WSA 03 2011 Water Supply Code of Australia
- WSA 04 2005 Sewage Pumping Station Code of Australia.

### 3.2 Guidelines

- Australian Rainfall & Runoff
- Austroads Waterway design. A Guide to Hydraulic design of Bridges Culverts and Floodways.

### 3.3 **RMS Specifications**

- RMS 3552 Subsurface Drainage Pipe (Corrugated Perforated and Non-Perforated Plastic)
- RMS D&C 3557 Flexible Strip Filter Drains
- RMS D&C 3058 Aggregate Filter Materials for Subsurface Drainage



- RMS Q6 RMS Specification D&C Q6 Quality Management System
- RMS D&C R11 Stormwater Drainage.

### 3.4 Council Standards

- North Sydney Development Control Plan 2013
- North Sydney Council, Performance Guide for Engineering & Construction
- North Sydney Council, Infrastructure specification for roadworks, drainage, and miscellaneous works 2016/2017
- Development Control plan 2002 and Area Character Statements.

### **3.5 Reference Documents**

- North Sydney LGA Flood Study Final Report North Sydney Council Febuary 2017 (NSFS)
- Sydney Metro City & Southwest Civil Design Report Crows Nest Station Stage 1 Design - Underground Stations Design & Technical Services - January 2018
- Sydney Metro City & Southwest Technical Services Hydrology and Drainage Chatswood to Sydenham Dive Reference Design TfNSW October 2016
- Sydney Metro City & Southwest Technical Services Utilities Diversion City -Reference Design - TfNSW - August 2016
- Sydney Metro City & Southwest Technical Services Civil, Structural, Geotechnical and Hydrology Report definition design TfNSW August 2016
- Sydney Metro City & Southwest Technical Services Northern Corridor Report -Reference Design - TfNSW - Febuary 2017
- Sydney Metro City & Southwest Technical Services Sydney Metro Trains Facility (South) - Civil, Structural, Geotechnical and Hydrology Report-Definition Design-TfNSW - Febuary 2017
- Sydney Metro City & Southwest Chatswood to Sydenham Environmental Impact Statement (EIS) - May 2016
- Sydney Metro City & Southwest Performance Requirement Brief (PRB) Over Station Development (OSD) Enabling works, Crows Nest Station-Draft, Revision 0.3 March 2017
- Sydney Metro City & southwest Chatswood to Sydenham Construction Traffic Management framework (CTMF) Version 4.5 18 April 2017.



# 4.0 Flooding

Crows Nest station is situated on the Pacific Highway in Crows Nest, which is the highest point in the catchment draining to Middle Harbour. The Crows Nest station site is highly urbanised and the streets have a steep gradient. Given the highly impervious nature of the Site surrounds, it is expected that storms of a "flash flood" nature would produce the worst-scenario flooding outcome around the proposed station.

Since public exhibition of the Crows Nest OSD concept SSD Application, the North Sydney LGA-Wide Flood Study model has been made available to CNDC for the Stages 2 and 3 detailed design of Crows Nest station. The resolution of this model was increased and the Stage 2 revised building footprint, Civil roadworks and proposed stormwater upgrades were modelled. The model was updated according to the more recently published Australian Rainfall and Runoff 2016 (AR&R2016) guidelines for flood estimation. The flood model was simulated for both the existing and Stage 2 post-development scenarios to define flood levels and velocities in the vicinity of Crows Nest Station. Flood protection levels for the revised OSD and station entrances were determined and a flood impact assessment has been undertaken to visualise flood level and velocity impacts caused by proposed works to ensure compliance with Sydney Metro - Chatswood to Sydenham SPIR REMM FH9. The impact of increased rainfall intensity due to climate change was assessed according to AR&R2016 procedures.

It is important to note that the Amended OSD scheme's revised land-use, reduction in building envelope and GFA have no bearing on the flood modelling, because flooding is mostly confined to the adjacent road corridors. Rather, changed flooding outcomes since the Exhibited OSD scheme are mostly a result of:

- Updates to the North Sydney LGA-Wide Flood Study model to increase modelling resolution. This has allowed for better visualisation of flowpaths around the full perimeter of Crows Nest station and OSD. Previously, due to the coarse nature of the North Sydney LGA-Wide Flood Study model, flood extents were not defined at all on Pacific Highway
- Crows Nest station design development from Stage 1 to Stage 2, including changes to the architectural layout of station/OSD entrances, Civil roadworks/footpath levels and proposal to upgrade the stormwater network.

The following sections describe the flood modelling methodology used by SMEC, including a fit-for-purpose review undertaken of this model, model results and design outcomes informed by flooding requirements.

### 4.1 Received Flood Model

The North Sydney Local Government Area (LGA) Flood Study (WMAwater, 2017) model was provided to CNDC by North Sydney Council (NSC) to use as the base case flood model for defining flood behaviour in the vicinity of Crows Nest Station. The objective of the North Sydney LGA Flood Study (WMAwater, 2017) was to investigate local overland flooding and mainstream flooding to determine the nature and extent of the flood hazard over the entire



LGA. It is acknowledged that this Flood Study model represents the best estimate of flood behaviour in the North Sydney LGA. Key features of the model are described in Table 4-1.

Consultant	WMAwater
Industry Standards used	Floodplain Development Manual (2005) and Australian Rainfall and Runoff Guidelines 1987 (AR&R1987)
Year Developed	February 2017
Hydrologic Modelling Software Used	DRAINS
Rainfall-Runoff Modelling Approach	ILSAX
Depression Storage	Paved Area: 1mm
	Supplementary Area: 1mm Grassed Area: 5mm
Soil Type (Horton Infiltration Curves)	3
Routing Method	Kinematic Wave Equation
Hydraulic Modelling Software Used	TUFLOW
Hydraulic Model Build	TUFLOW.2013-12-AC-w64 (Double Precision)
Hydraulic Model Grid Resolution	2 m

Table 4-1 North Sydney LGA Flood Model Characteristics

SMEC undertook a thorough review of the North Sydney LGA Flood Study model to determine whether it was fit for purpose for defining flood behaviour in the immediate vicinity of the OSD. A number of justifiable changes were made to the LGA Flood Study model as described in sections 4.2 and 4.3.

### 4.2 Hydrologic Model Review

Aside from the following adjustments, the inherited LGA Flood Study hydrologic model was unchanged:

 The sub-catchment delineation in the LGA Flood Study model was coarse in the upstream reaches of the catchment where the OSD is located. As such, the flood extent in the LGA Flood Study was not defined on the Pacific Highway adjacent to Sites A and B. SMEC split "NSB002", "NSB003" "NSB004" and "NSB005" subcatchments into smaller sub-catchment areas to enable the visualisation of overland flow paths upstream of the station and in adjacent road corridors (refer Table 4-1). This was necessary to provide flood protection levels at the site of the OSD around entrances and egress points leading underground.





Figure 4-1 Sub-catchment delineation in the vicinity of Crows Nest station.

© Sydney Metro 2020

Page 22 of 53



- The LGA Flood Study did not assess storm durations shorter than 15 minutes. SMEC added the 5 minute and 10 minute storm durations to the DRAINS model and determined that the 5 minute storm duration was critical storm event for Crows Nest Station. This resulted in a marginal increase in flows at Crows Nest station compared to the flows generated by the LGA Flood Study DRAINS model
- The LGA Flood Study DRAINS model was originally developed using AR&R1987 procedures. CNDC upgraded the model to AR&R2016. This also resulted in a marginal increase in flows at Crows Nest station compared to the flows generated by the LGA Flood Study DRAINS model.

### 4.3 Hydraulic Model Review

Aside from the following adjustments, the inherited LGA Flood Study hydraulic model was unchanged:

- The TUFLOW model resolution was increased by adjusting the 2D cell size from 2 m to 1 m
- The extent of the LGA Flood Study TUFLOW model was trimmed such that the downstream boundary is 400 m downstream of Crows Nest station. This vastly reduced the model computational time
- The TUFLOW model build was upgraded to TUFLOW.2018-03-AB (Single Precision) to utilise the TUFLOW HPC solver with GPU hardware
- The TUFLOW grid orientation was realigned to match the orientation of the gridded streets and overland flow paths through buildings in the vicinity of Crows Nest station
- Detailed site survey and breaklines in the gutter inverts (issued to SMEC on 30/08/2019) were read into the TUFLOW model to represent the ground topography for existing conditions around Crows Nest station
- Pipe elements in the LGA Flood Study model less than 450 mm in diameter were assumed fully blocked. CNDC activated these pipe elements to visualise flood impacts resulting from upgrading the stormwater network in the vicinity of Crows Nest station
- Some 1d network branches were discontinuous near the site of interest in the LGA Flood Study TUFLOW model. This was rectified by SMEC
- Some inlet pits in the vicinity of Crows Nest station were moved to the gutter invert captured in the detailed site survey and the ground elevation at the pits was lowered using a "SXL" flag to ensure pit inlet capacity was not underestimated
- AR&R2016 inlet blockages were applied to inlet pits in the vicinity of the station (refer Table 4-2)



INLET TYPE	TYPE OF STRUCTURE	AR&R2016 DESIGN BLOCKAGE1	ADOPTED BLOCKAGE
	Kerb inlet only	0-20%	20%
Sag karb inlate	Grated inlet only	0-50%	50%
Sag kerb mets	Combined inlets	Capacity of kerb opening with 100% blockage of grate	50%
On grada karb	Kerb inlet only	0-20%	20%
	Grated inlet only	0-50%	50%
inlets	Combined inlets	10% blockage of combined inlet capacity on continuous grade	10%

Table 4-2 AR&R2016 pit inlet blockages adopted in the vicinity of Crows Nest station

- A post-development TUFLOW scenario was made to represent the Civil Works associated with the Crows Nest station for undertaking a flood impact assessment. The date of issue of the Civil design modelled in TUFLOW is 30/08/2019
- Stormwater upgrades for the local roads surrounding Crows Nest station were modelled as part of the post-development TUFLOW scenario. The modelled stormwater network was based on the design discussed in Section 5.4 (dated 15/10/2019).

These changes to the inherited flood model were made to better represent the topography and stormwater system capacity in the vicinity of the Site. This in turn has allowed SMEC to estimate flow conveyance in the road corridors more accurately near the Site. The flood levels did not change significantly as a result of the changes made to the inherited flood model.

### 4.4 Modelling Results

Figures showing depth, velocity, flood level impact and velocity impact mapping are provided in Appendix A.

#### 4.4.1 Flood Depth

The flood depths for the Amended OSD scheme are similar to those reported for the Exhibited OSD scheme.

Given the positioning of the Site at the top of the catchment and steep gradient of the adjacent roads, the 1% AEP flood depths in the gutter next to the Site are typically less than 150 mm, with the exception of an undrained sag on Pacific Highway adjacent to Site A where the gutter flow depth in the design scenario is 200 mm. Similarly, the PMF flood depths in the gutter next to the Site are typically less than 250 mm with the exception of the Pacific Highway undrained sag next to Site A, where the PMF flood depth in the design scenario is 320 mm.

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -

Appendix G: Flood Assessment and Stormwater Management Plan

<sup>&</sup>lt;sup>1</sup> AR&R2016 Book 9, Chapter 6, Table 9.5.1 – Suggested Design and Severe Blockage Conditions for Inlet Pits Book 6, Chapter 6.



#### 4.4.2 Flood Level Impacts

Flood level impacts were not previously assessed for the Exhibited OSD Scheme.

For the Amended OSD scheme, 1% AEP flood level impacts are shown in Figure 4-2. As per Sydney Metro – Chatswood to Sydenham SPIR REMM FH9, 1% AEP flood impacts up to 50 mm are acceptable.

It is noted the OSD building footprint covers the same surface area as the existing site. The adverse flood impacts are therefore not a result of flow obstructions related to an increased building footprint occupying the Site, rather by regarding the roads and footpaths near the Site.

Proposed regrading of Hume Street near the intersection with Pacific Highway will direct an additional 0.15 m3/s of flow along Hume Street that would otherwise bypass and continue flowing north-west along Pacific Highway. A large portion of this flow will be captured by the upgraded stormwater system along Hume Street and Clarke Street. Flood level impacts greater than 50 mm are observed in the road corridor along Hume Street as a result of the road level being lifted and the flood level being lifted with it. However, as demonstrated in Figure 4-3, the flood depth increase is less than 50 mm across the site, demonstrating compliance with Sydney Metro - Chatswood to Sydenham SPIR REMM FH9.

The proposed regrading of Clarke Lane has reduced the flood extent on the lane itself but has resulted in a new flood extents along the boundary of 28-34 Clarke Street (corner of Oxley Street and Clarke Street). However, the flood depth at the property boundary is very shallow in the design scenario (less than 50 mm) and the building would not experience above-floor inundation.

The proposed regrading/lifting of Hume Street between Pacific Highway and Clarke Street has caused flood impacts greater than 50 mm in the road corridor, as well as new flood extents along the boundary of 28 - 34 Clarke Street (corner of Oxley Street and Clarke Street). However, the flood depth at the property boundary is very shallow in the design scenario (less than 50 mm) and the building would not experience above-floor inundation.





Figure 4-2 1% AEP flood level impacts in the vicinity of Crows Nest Station.

© Sydney Metro 2020

Page 26 of 53





Figure 4-3 1% AEP flood depth impacts in the vicinity of Crows Nest station.

© Sydney Metro 2020

Page 27 of 53



#### 4.4.3 Flood Velocity Impacts

Flood velocity impacts were not previously assessed for the Exhibited OSD Scheme.

The percentage change in flow velocity from the existing scenario to design scenario was mapped to determine if there were any locations subject to new scour risk as a result of the Works. Where existing flow velocities are greater than 1 m/s, all surfaces experiencing a velocity increase are paved and resistant to scour. Percentage changes in absolute velocities less than 1 m/s are not considered significant.

#### 4.4.4 Changes to Inundation Time

Changes to inundation time were not previously assessed for the Exhibited OSD Scheme.

As per Sydney Metro – Chatswood to Sydenham SPIR REMM FH9, a maximum increase in time of inundation of 1 hour in the 1% AEP flood event is acceptable. The critical storm duration in the vicinity of the Site is short (5 – 15 minutes) and there is very little flood attenuation occurring due to the steep and paved nature of the catchment. As a result, time of inundation as a result of the Works would not increase.

#### 4.5 Flood Planning Requirements

Sydney Metro – Chatswood to Sydenham SPIR REMM FH10 states that, where feasible and reasonable, station and service entrances to underground stations must be set above the greater of the 1% AEP flood level plus 500 mm freeboard or the PMF. This requirement contradicts the public exhibition version of the Crows Nest OSD concept SSD Application, which states that flood protection levels for all station and OSD entries are to be determined as the maximum of:

- The PMF flood level
- 300 mm above the surveyed ground level at the entrance thresholds.

SMEC identified the following with this flood protection definition:

- It was assumed in the exhibited scheme of the Crows Nest OSD that the OSD, metro tunnel and station were all interconnected. However, based on the amended design, only one OSD egress stair will be interconnected with the underground railway infrastructure (OSD\_01 shown in Figure 4-4). The remaining OSD entrances would either connect with above ground floor levels of the OSD or are not connected with the underground rail infrastructure and therefore do not require additional flood protection requirements
- Providing flood protection by setting entrances 300 mm above the surveyed existing ground level does not account for the possibility of the proposed Civil level at the entrance threshold being higher than the surveyed level. In this case, less than 300 mm freeboard would be achieved.



#### 4.5.1 Sydney Metro City and Southwest Design Criteria

The Criws Nest station design adopted a flood protection level for all entrances, ventilation openings, tunnel portals and other openings into underground railway infrastructure as the maximum of:

- The PMF flood level; and
- 300 mm above the surrounding finished ground level or sufficient to prevent local flash flooding entering the underground structures. At the station entrances, this requirement must be met by sloping the surface away from the threshold and not by a step.

The PMF flood depth at the boundary of Sites A, B and C never exceeds 300 mm. This indicates that the governing flood protection level for all entrances, ventilation openings, tunnel portals and other openings into underground railway infrastructure is 300 mm higher than the surrounding finished ground level or sufficient to prevent local flash flooding.

The surrounding finished ground level refers to the proposed Civil level at the site boundary. Surrounding finished ground levels were sampled directly adjacent to the upstream side of the station entrances.

Flood protection levels were determined at a number of locations around the perimeter of the Site for entrances into underground railway infrastructure based on the architectural Revit model issued for coordination on 17/10/2019 (refer Figure 4-4 and Table 4-3). A number of additional accesses to underground infrastructure have been added since the Stage 1 design upon which the Crows Nest OSD SSD Application was based.





Figure 4-4 OSD Entries and Egresses to the underground Crows Nest station.

© Sydney Metro 2020

Page 30 of 53



 
 Table 4-3 CNDC Stage 2 Design Finished Floor Levels of entrances into underground rail infrastructure and provided freeboard. Comparison provided to Exhibited Flood Protection Level (FPL).

ID	ENTRY TYPE	PMF FLOOD LEVEL (M AHD)	SURROUNDIN G FINISHED GROUND LEVEL (SFGL) (M AHD)	FINISHED FLOOR LEVEL (FFL) (M AHD)	FFL - SFGL (M)	COMPARISON TO EXHIBITED FPL
OSD_01	OSD Egress (Site B)	92.27	92.63	92.93	300	Entrance not present in Stage 1 Design
STN_1	Pacific Highway Entrance and Access Hatch	88.2	88.23	88.44	210	FPL = 88.48 m AHD FFL = 87.84m AHD Flood barrier required.
STN_2	Access Hatch (Site A)	85.84	86.03	86.35	320	Entrance not present in Stage 1 Design
STN_3	Egress Stair 1 (Site A)	85.92	86.11	86.45	340	Entrance not present in Stage 1 Design
STN_4	Egress Stair 2 (Site A)	85.96	86.14	86.44	300	Entrance not present in Stage 1 Design
STN_5	Egress Stair 1 (Site B)	94.57	94.61	94.91	300	Entrance not present in Stage 1 Design
STN_6	Egress Stair 2 (Site B)	94.22	94.25	94.55	300	Entrance not present in Stage 1 Design
STN_7	Access Delivery Hatch (Site B)	93.97	94.28	94.85	570	Entrance not present in Stage 1 Design
STN_8	Egress Stair 3 (Site B)	93.18	93.53	93.83	300	FPL = 94.47 m AHD FFL = 94.56 m AHD 300 mm internal step provided
STN_10	Clarke Street Entrance (Escalator)	88.44	88.38	88.59	210	FPL = 88.92 m AHD FFL = 89.00 m AHD No additional flood protection

© Sydney Metro 2020

Page 31 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -

Appendix G: Flood Assessment and Stormwater Management Plan



ID	ENTRY TYPE	PMF FLOOD LEVEL (M AHD)	SURROUNDIN G FINISHED GROUND LEVEL (SFGL) (M AHD)	FINISHED FLOOR LEVEL (FFL) (M AHD)	FFL - SFGL (M)	COMPARISON TO EXHIBITED FPL
						measures required.
STN_11	Clarke Street Entrance (Lift Shaft)	88.69	88.71	88.69	-20	Entrance not present in Stage 1 Design

All egress routes directed to underground structures are designed with a minimum 300 mm internal step - see DP01 - Architecture Design Package for section details. Therefore, flood protection is achieved to 300 mm above surrounding finished ground level.

Clarke Street and Pacific Highway station entrances are subject to significant architectural constraints. As such, it is not possible to achieve 300 mm crest protection to the surrounding finished ground level at the station entrances. However, a more detailed hydraulic assessment using Manning's equation was undertaken adjacent to the station entrances to estimate the required 1% AEP freeboard to prevent ingress of flood water into Crows Nest station.

Based on this hydraulic assessment, providing a freeboard of 210 mm to surrounding finished ground level at the Clarke Street entrance escalator and 210 mm at the Pacific Highway entrance is considered adequate to prevent local flash flooding entering the underground infrastructure.

The lift shaft at the Clarke Street entrance is 20 mm below the adjacent finished ground level at the site boundary. This does not comply with Sydney Metro's flood protection requirement and will be rectified at the Stage 3 design.

#### 4.5.2 Other Entrances

No guidance has been provided by Sydney Metro on setting flood protection levels for OSD entrances which do not lead into underground railway infrastructure. However, the flood modelling undertaken as part of this assessment demonstrates that there is low risk of flooding around these entrances as they are outside the PMF flood extent.

It is recommended that for entrances <u>not</u> leading to underground railway infrastructure are set above the Flood Protection Level defined in Table 4-4. The Flood Protection Level is based on the larger of the PMF flood level and the surrounding finished ground level at the entrance threshold. Note that no freeboard is the required for these entrances.



ID	ENTRY TYPE	PMF FLOOD LEVEL (M AHD)	SURROUNDING FINISHED GROUND LEVEL (SFGL) (M AHD)	REQUIRED FLOOD PROTECTION LEVEL (M AHD)	BASIS OF FLOOD PROTECTION LEVEL
OSD_02	OSD Entry 1 (Site B)	91.97	92.32	92.32	SFGL
OSD_03	OSD Entry 2 (Site B)	91.02	91.20	91.20	SFGL
OSD_04	OSD Entry (Site C)	90.25	90.27	90.27	SFGL
OSD_05	OSD Entry (Site A)	90.73	90.83	90.83	SFGL

Table 4-4 Required Flood Protection Levels for OSD entrances.

The two loading docks proposed in the Crows Nest station Stage 2 design will be waterproofed, preventing the passage of floodwater into underground rail infrastructure via the loading docks.

### 4.6 Climate Change Sensitivity

In the METRON Stage 1 Civil design report, the Department of Environment and Climate Change (DECC) Floodplain Risk Management Guideline – Practical Consideration of Climate Change, version 1 October 2007 was relied upon for guidance on increased rainfall intensity caused by climate change. This document recommended undertaking a sensitivity analysis with a 10%, 20% and 30% increase in rainfall intensity to represent the effects of climate change. However, guidance in this document has been superseded by the Australian and Runoff 2016 guidelines. CNDC have sought approval from Sydney Metro to use AR&R 2016 guidelines to assess climate change.

The adopted climate change factor of 19.7% for the 1% AEP event rainfall is derived from the 2090 representative concentration pathway (RCP) scenario 8.5 conditions for the Crows Nest location, as recommended by AR&R 2016. It shall be noted that sea-level rise will not impact the Site which is situated at an elevation of around 88 m AHD.

As shown in the Appendix A and , the 1% AEP + 19.7% increase in rainfall intensity flood level adjacent to the Site is always lower than the PMF flood level. This indicates that climate change will have no impact on the flood protection levels for Crows Nest station. Furthermore, 1% AEP flood levels are not sensitive to climate change in the vicinity of Crows Nest station. The flood level increase as a result of climate change at station entrances and accesses is shown in Table 4-4.

The climate change sensitivity results are similar to those reported in the METRON Stage 1 Civil Design Report, which did not exceed 60 mm.



	FLOOD DEPTH (M)		FLOOD LEVEL (M AHD)		FLOOD LEVEL
ID	1% AEP	1% AEP plus 19.7% increase in rainfall intensity	1% AEP	1% AEP plus 19.7% increase in rainfall intensity	SENSITIVITY TO CLIMATE CHANGE (M)
OSD_01	0.00	0.01	92.24	92.24	0.00
OSD_02	0.00	0.01	91.94	91.94	0.00
OSD_03	0.01	0.01	90.99	90.99	0.00
OSD_04	0.00	0.01	90.08	90.09	0.01
OSD_05	0.06	0.08	90.65	90.67	0.02
STN_1	0.04	0.05	88.08	88.09	0.01
STN_2	0.00	0.00	N/A	N/A	0.00
STN_3	0.00	0.00	N/A	N/A	0.00
STN_4	0.00	0.00	N/A	N/A	0.00
STN_5	0.06	0.07	94.50	94.51	0.01
STN_6	0.10	0.11	94.15	94.15	0.01
STN_7	0.00	0.00	93.92	93.92	0.00
STN_8	0.00	0.01	93.14	93.14	0.00
STN_10	0.03	0.04	88.34	88.36	0.02
STN_11	0.07	0.09	88.61	88.64	0.02

#### Table 4-5 Flood Level Climate Change Sensitivity

© Sydney Metro 2020

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -

Appendix G: Flood Assessment and Stormwater Management Plan



## 5.0 Stormwater Drainage Design

This section describes the revised stormwater management strategy as a result of the amended over station building proposal. The key difference is the removal of the underground detention tank at Clarke Lane proposed in the Original Scheme.

It should be noted that in-ground stormwater management, including the modification of existing stormwater assets and installation of new stormwater assets will be undertaken as part of the CSSI approval. This strategy is aimed at reducing the potential for future disruption of footpath access should the OSD construction of Site A and B be delayed after the completion of the station and Site C and remove the need for detrimental construction works to the Metro Station and surrounding areas.

### 5.1 Design Objectives

Technical requirements for site detention have been developed to comply with NSC's Stormwater Management Policy and Permissible Site Discharge (PSD) for the 100-year Average Recurrence Interval (ARI).

NSC's detention system design requirement is that the maximum site discharge does not exceed that which would occur during a 5-year average recurrence interval (ARI) event (under existing site conditions) for all storm events up to and including the 100-year ARI event. The discharge for the 5-year average recurrence interval (ARI) event is presented in Table 5-1.

### 5.2 Existing Drainage

As shown in Figure 5-1, NSC owns existing underground stormwater drainage assets (solid blue lines) along the southern side of Oxley Street, the western side of Clarke Street and the southern side of Hume Street.

Detailed stormwater survey indicates that the drainage line along Clarke Street to the junction at Oxley Street is a nominal 375mm pipeline. This was assumed to be a 450mm pipe in the Original Scheme. The drainage lines in Hume Street are noted to range between 300mm, 375mm and 525mm nominal pipe size eventually connecting into a 750mm pipe at the corner of Clarke Street and Oxley Street.




Figure 5-1 Pre-Existing Council Stormwater Drainage assets (solid blue lines) indicatively shown (North Sydney Council, 2017)

## 5.3 Existing Site Runoff

Existing site runoff was derived from the calculated area of each Lot (Sites A, B and C). The existing 5yr ARI runoffs were subsequently calculated and are presented in Table 5-1. The calculated runoff values are slightly lower (and therefore more conservative) than those indicated in the original SSDA application. The design also uses a conservative approach by not applying climate change factors to these existing site runoff flows. This results in more stringent PSD requirements.

The OSD detention stategy is only applicable to the area within the property boundary at Sites A, B and C. This includes the proposed building footprint and a small pavement catchment that envelopes the building.

DRAINS model data has been included in Appendix .

© Sydney Metro 2020

Page 36 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -Appendix G: Flood Assessment and Stormwater Management Plan



#### Table 5-1 Pre-Existing Condition Site Flows

Catchment	Lot Area (m2)	Existing 5YR ARI flow (L/s)
Site A	3879.2	151
Site B	1872.4	73
Site C	606.8	24

## **5.4 Proposed Drainage Strategy**

The proposed detention strategy requires installation of separate detention tanks within the future OSD at Sites A, B and C. These will discharge to the in-ground stormwater system via downpipes provided in the Crows Nest Station design.

### 5.4.1 Site A Drainage

The Site A OSD building design has been revised in the Amended OSD Scheme. The exhibited scheme proposed two separate towers divided by a central podium deck. The original detention strategy involved use of detention tanks within each tower and an underground detention tank in Clarke Lane to attenuate flows from the podium deck. The amended building design adopts a single-stepped tower form and the podium deck has been removed. This allows the underground detention tank at Clarke Lane to also be removed.

The revised Site A drainage strategy proposes collection of roof catchments and conveyance of these flows to an on-site detention system. As the proposed station footprint is offset from the site boundary, a small area around the building envelope will not fall on the building roofs and will therefore bypass the detention system.

The station design has made provision for three tanks to be incorporated in the future development at Site A. These tanks can discharge through three connection points indicated in Figure 5-2 below. The station design incorporates two 300mm diameter downpipes, DPA2 and DPA3. A 225mm diameter stub pipe (DPA1) is also provided for a third OSD downpipe connection. These stormwater connection points have been provided for conveyance of OSD detention tank discharge into the council stormwater system.

© Sydney Metro 2020





Figure 5-2 Site A Connecting Downpipes to Council System

Installation of these two downpipes and stub pipe as part of station construction will allow the OSD construction to proceed without interruption to the station services.



### 5.4.2 Site B Drainage

Similar to the original scheme, the Site B roof will capture stormwater and convey this through down pipes to a detention system within the building.

As per the Site A approach, the station design makes provision for two tanks to be incorporated in the future development at Site B. These tanks may discharge through two connection points indicated in Figure 5-3 below. The station design incorporates two 225mm diameter downpipes, DPB1 and DPB2. These stormwater connection points have been provided for conveyance of OSD detention tank discharge into the council stormwater system.



### Figure 5-3 Site B Connecting Downpipes to Council System

Provision of these downpipes within the station allow the OSD construction to proceed without interruption to the station services.

The small catchment around the roof area will bypass the OSD. No GPT units are proposed to treat Site B runoff as indicated in the Exhibited OSD Scheme. Refer to Section 6 for water quality treatment strategy.

### 5.4.3 Site C Drainage

The stormwater and detention strategy at Site C has been retained from the Exhibited OSD Scheme.

© Sydney Metro 2020



### 5.4.4 Detention Tanks and Downpipes

All detention tanks will discharge rainwater into the Council stormwater system. The discharge from the site will be restricted to comply with NSC on-site detention and permissible site discharge (PSD) requirements.

Site A, B and C have on-site detention tanks located with the OSD buildings as per the Exhibited OSD Scheme. However the underground detention tank at Clarke Lane has been removed in the revised scheme.

Downpipes provided in the station design have capacity to take unattenuated flows for a 100year ARI event from the sites. This is to cater for blocked conditions within the detention tanks that could result in unattenuated flows leaving the site.

The future developments are considered high-rise buildings. Vertical face catchments arising from wind-driven rain (as described in Australian Standards AS3500 Section 3.4.4) has not been considered in detention modelling. However, the downpipes are sized to take unattenuated flows from vertical face catchments (for example from balcony drains and awnings) for a 100 year ARI storm event. Future developmet applications will be required to assess the requirements for vertical face catchments in consultation with key stakeholders such as NSC.

### **5.5 Detention Modelling**

Similar to the modelling approach documented in the Exhibited OSD Scheme, DRAINS was used for hydrologic and hydraulic modelling to develop a detention strategy. DRAINS is a computer simulation model that incorporates the ILSAX hydrologic model for calculating peak flows and then performs hydraulic modelling of the drainage network including pits, pipes and tanks.

The model was run for storms up to the 100-year ARI events. Results for these events have been included in this Appendix C.

Modelling parameters and assumptions used are consistent with those documented in the Exhibited OSD Scheme.

It should be noted that the existing 5 yr ARI flows have been determined with no climate change factor applied to rainfall data. However, the 100 yr ARI discharges for the OSD Configuration use a 19.7% climate change factor applied in line with ARR 2016 recommendations. This conservative approach results in more stringent PSD requirements.

### 5.6 Modelling Results

The analysis in DRAINS has been undertaken to provide preliminary detention tank sizing. The DRAINS model confirms that sites meet Council's PSD objectives. Refer to Table 5-2 below. See Appendix C for proposed catchment plan and Appendix C for the proposed OSD DRAINS detention modelling data.



### Table 5-2 DRAINS Modelling Results

Catchment	Existing 5YR ARI flow (Permissible Site Discharge) (L/s)	100 YR ARI Discharge Over Station Development Configuration (L/s)
Site A	151	140
Site B	73	67
Site C	24	21

The preliminary tank sizing requirements that comply with NSC's Permissible Site Discharge limits are indicated in Table 5-3 below:

### Table 5-3 Preliminary Tank Sizing

Catchment	Number of Tanks	Tank Surface Area (m2)	Tank Height (m)	Tank Orifice Size (mm)
OSD Site	3			
А		14	2.5	130
OSD Site	2			
В		14	2	110
OSD Site	1			
С		35	2.5	75

The tank sizing accounts for proposed floor heights of 3.8m and 3.2m for the OSD storeys at Sites A and B respectively. These tank dimensions form part of technical advice by CNDC to the future OSD developer. It is the OSD developer's responsibility to demonstrate compliance with NSC's PSD requirements indicated in Table 5.1.

### 5.7 Recommendations

### 5.7.1 Final tank sizing

The preliminary tank sizing indicated in Table 5-3 above may be revised as the design of the OSD building develops. The OSD developer may also choose to use less tanks than proposed inTable 5-3. It is the OSD designer's responsibility to demonstrate the compliance of the final detention strategy of the OSD buildings with NSC's requirements.



## 5.8 Down Pipe Coordination

As per the Exhibited OSD Scheme, all proposed OSD down pipes and their connections are to be constructed during the CSSI Approval to enable OSD drainage after the construction of the Crows Nest Station. This is to prevent additional, detrimental, construction works within and around the proposed Crows Nest Station.

© Sydney Metro 2020

Page 42 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -Appendix G: Flood Assessment and Stormwater Management Plan



## 6.0 Stormwater Quality

A revised water quality strategy has been developed for the revised OSD design. The key difference is the absence of central podium deck at Site A in the revised OSD design, that was to use a green roof design for water quality treatment. To compensate for this, green roof areas are proposed for sections of the roof areas on Sites A, B and C. The use of proprietary water quality treatment units has also been rationalised.

## 6.1 Water Quality Objectives

The pollution reduction targets from the relevant councils / authorities are summarised in Table 6-1. NSC has confirmed the below targets which differ from those documented in the Original Scheme. Correspondence with NSC is captured in Appendix E.

Reference	Pollution Red Total Suspended Solid (kg/yr)	uction Target Total Phosphorous (kg/yr)	Total Nitrogen (kg/yr)	Gross Pollutants (>5mm)	Reference
North Sydney Council	80%	45%	45%	70%	Appendix K
Green Star 5 Star Design and As Built	80%	60%	45%	90%	Green Building Council of Australia, (2010), "Emi-5 Stormwater"

### Table 6-1 Pollution Reduction Targets

The amended OSD scheme is expected to provide necessary pollution reduction measures to achieve the Green Star rating target for stormwater.

## 6.2 Modelling Approach

### 6.2.1 MUSIC

A MUSIC model was developed to assess the revised water quality strategy. The modelling approach and assumptions used in the Orginal Scheme were retained. Green roof areas were modelled using the 'Bioretention' treatment node in MUSIC.

Refer to Appendix D for Further MUSIC Data inputs and information.

### 6.2.2 Methodology

A post development model of the OSD was developed to estimate the pollutant loads generated by the site as a result of re-development.

© Sydney Metro 2020



To mitigate the increase in pollutant loads, a MUSIC model was developed incorporating treatment systems such as Gross Pollutant Traps (GPTs), Rainwater tanks and proprietary filtration devices and green roof installations. The green roof schematic presented in the original scheme can be retained in the revised scheme. See Figure 6-1 below:



Figure 6-1 Proposed Green Roof Drainage Schematic

## 6.3 Model Inputs

Modelling inputs and assumptions including meteorological data, evapotranspiation, soil properties are retained from the original scheme. However, catchment areas for the OSD buildings have changed due to the revised OSD design.

The catchment summary for the revised MUSIC model is presented in the Table 6-2 below.

Catchment ID	Area (ha)	Area Type	Percent Impervious
A	0.115 (Roof Catchment 1) 0.107 (Roof Catchment 2) 0.117 (Roof Catchment 3)	Mixed	100%
	0.015 (Pavement Catchment 1) 0.035 (Pavement Catchment 2-Bypass)		100 //
В	0.077 (Roof Catchment 1) 0.083 (Roof Catchment 2) 0.009(Pavement Catchment 1)	Mixed	100%

Table 6-2 Catchment Summary

© Sydney Metro 2020

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -

Appendix G: Flood Assessment and Stormwater Management Plan



Catchment ID	Area (ha)	Area Type	Percent Impervious
	0.019 (Pavement Catchment 2 -Bypass)		
C	0.053 (Roof Area)	Mixed	100%
C	0.007 (Pavement Catchment -Bypass)	Mixed	100 /0

A high impervious area was selected as there is a concrete slab under the vegetated area and it is likely that most of the run-off will be captured by the rainwater harvesting system.

## 6.4 Proposed Treatment Devices

A preliminary MUSIC model was developed, incorporating potential feasible water quality treatment measures to achieve the more stringent Green Star (B) stormwater quality targets. Refer to Table 6-1.

The revised site MUSIC model layout is shown in Figure 6-2. The areas boxed in red represent treatment measures that are the responsibility of the OSD developer to further investigate as part of their design.

Water quality outcomes for the OSD are improved by in-ground treatment methods proposed to be installed as part of the station design. These measures are shown inside the blue box in Figure 6-2. A hydrodynamic separator unit (Humes Humeceptor STC2 or approved equivalent) is proposed to receive and treat catchment runoff from Site A. Litter Baskets (EcoSol or approved equivalent) are also proposed to be installed in several in-ground stormwater pits to capture gross pollutants and suspended solids. Pits with litter baskets incorporate a 350mm drop to facilitate the installation of the basket. They will require regular maintenance and cleaning particularly after major storm events.

Trench drains have been incorporated in the footpath as part of the station drainage design. These will capture and direct footpath runoff to litter baskets and the Humeceptor unit to improve pollutant removal.





Figure 6-2: MUSIC Model Layout

### 6.4.1 Treatment Measures within OSD Envelope

The OSD developer will need to incorporate treatment measures within the OSD building design for Sites A and B. For example, roof gardens and rainwater tanks could be used to achieve water quality outcomes. For the roof gardens, the revised MUSIC model assumes 50% of the related roof catchments is treated while 50% will bypass this treatment measure. Detention tanks required for attenuation will also perform a treatment function.

As part of future development applications a detailed water quality analysis to demonstrate the compliance of the OSD with NSC requirements will be required.

## 6.5 Stormwater Quality Modelling Results

Preliminary MUSIC model results and treatment train effectiveness for the revised scheme are summarised in Table 6-3. Modelled results indicate that the proposed treatment train will meet Council requirements and Green Star target rating targets.



#### Table 6-3 MUSIC Modelling Results

	Developed	d Scenario	Pollutant	Green Star
Model Output Parameters	Source Load	Residual Load	Reduction	rating Targets <sup>1</sup>
Total Suspended Solids (kg/yr)	1830	268	85.4%	80%
Total Phosphorus (kg/yr)	3.64	1.06	70.9%	60%
Total Nitrogen (kg/yr)	25.2	13.7	45.7%	45%
Gross Pollutants	209	20.1	90.4%	90%

<sup>1</sup> Emi-5 Storwater reduction B targets (Table Emi-5.1; Green Building Council of Australia)

This water quality management strategy will be further developed as part of detailed design of the OSD to meet pollution reduction targets.



## 7.0 Conclusion

This report outlines the amendments to the flooding and stormwater strategy since the exhibited Crows Nest OSD SSD Application was placed on public exhibition in November 2018.

Detailed flood modelling undertaken since the public exhibition has demonstrated that the amended OSD will not generate adverse flood impacts to nearby properties. It is proposed that flood protection levels for all OSD below ground entrances such as to the underground rail infrastructure are to be set above the PMF flood level or 300 mm higher than the surrounding finished ground level or sufficient to prevent local flash flooding ingress.

For OSD entries, the recommended flood protection level shall be the larger of the PMF flood level and the surrounding finished ground level at the entry threshold.

As per the exhibited scheme, all in-ground stormwater management, including the modification or diversion of existing stormwater assets will be undertaken as part of the CSSI approval. This strategy is aimed at reducing the potential for future disruption of footpath access should the OSD construction be delayed after the completion of the station and remove the need for detrimental construction works to the Metro Station and surrounding areas.

On-site detention strategy has been revised due to the Amended OSD scheme. The underground detention tank at Clarke Lane has been removed and all detention tanks are to be accommodated within the OSD development. Tank sizing has been revised based on Amended OSD Scheme to meet NSC's permissible site discharge requirements.

A revised water quality analysis for the OSD developments demonstrates how a possible treatment train strategy can meet both Council's treatment targets and the Green Star rating target for stormwater. The green roof provided on the podium deck at Site A in the Orginal Scheme is no longer applicable. Green roofs are recommended for areas of roof catchments to compensate. Other treatment measures that may be used include, rainwater tanks, proprietary filtration units and litter baskets.

© Sydney Metro 2020



## Appendix A

**Flood Mapping** 

© Sydney Metro 2020

Page 49 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -Appendix G: Flood Assessment and Stormwater Management Plan



COORDINATE SYSTEM Datu	m: GDA94 Projection: MGA Zone 56	NORTH	DRAWIN	G NO. A01	REVISIO	ON IDC	STATUS STAGE 2
PAGE SIZE A3			CREATE	DBY M.HARTY	DATE	16/10/2019	
PROJECT NO. 30012631	PROJECT TITLE CROWS NEST STATION DE	ESIGN	TITLE	1% AEP Flood De Existing Scenario	epth D		





COORDINATE SYSTEM Datu PAGE SIZE A3	m: GDA94 Projection: MGA Zone 56	DRAWIN CREATE	ng No. A02 Ed by M.Harty	REVISIO DATE	N IDC 16/10/2019	STATUS STAGE 2
PROJECT NO. 30012631	PROJECT TITLE CROWS NEST STATION DESIGN	TITLE	PMF Flood Depth Existing Scenario			





COORDINATE SYSTEM Datu	im: GDA94 Projection: MGA Zone 56	NORTH	DRAWING	NO. A03	REVISION	IDC	STATUS STAGE 2
PAGE SIZE A3			CREATED	BY M.HARTY	DATE 16	6/10/2019	
PROJECT NO. 30012631	PROJECT TITLE CROWS NEST STATION DES	IGN	TITLE	1% AEP Flood Design Scenar	Depth io		





COORDINATE SYSTEM Datu	m: GDA94 Projection: MGA Zone 56	NORTH	DRAWING N	<mark>O</mark> . A04	REVISIO	N IDC	STATUS STAGE 2
PAGE SIZE A3			CREATED B	Y M.HARTY	DATE	16/10/2019	
PROJECT NO. 30012631	PROJECT TITLE CROWS NEST STATION D	ESIGN	TITLE         1% AEP Flood Depth           Design Scenario - 19.7% increase in rainfall intensity				infall intensity





COORDINATE SYSTEM Datu PAGE SIZE A3	m: GDA94 Projection: MGA Zone 56	DRAWIN CREATE	NG NO. A05 ED BY M.HARTY	REVISIO DATE	N IDC 16/10/2019	STATUS STAGE 2
PROJECT NO. 30012631	PROJECT TITLE CROWS NEST STATION DESIGN	TITLE	PMF Flood Depth Design Scenario			





COORDINATE SYSTEM Datum: GDA94 Projection: MGA Zone 56			g no.	A06	REVISI	ON IDC	STATUS STAGE 2
PAGE SIZE A3		CREATE	D BY	M.HARTY	DATE	16/10/2019	
PROJECT NO. 30012631	PROJECT TITLE CROWS NEST STATION DESIGN	TITLE	1% A Exist	AEP Flood Velo ting Scenario	city		





COORDINATE SYSTEM Datu	m: GDA94 Projection: MGA Zone 56	JORTH	DRAWIN	<mark>G NO</mark> . A07	REVISI	ON IDC	STATUS STAGE 2
PAGE SIZE A3			CREATE	DBY M.HARTY	DATE	16/10/2019	
PROJECT NO. 30012631	PROJECT TITLE CROWS NEST STATION DESI	GN	TITLE	1% AEP Flood Ve Design Scenario	locity		





COORDINATE SYSTEM Datu	m: GDA94 Projection: MGA Zone 56	RTH	DRAWING	à NO.	A08		REVISIO	N IDC		STATUS	STAGE 2
PAGE SIZE A3			CREATE	BY	M.HARTY		DATE	16/10/2019	)		
PROJECT NO. 30012631	PROJECT TITLE CROWS NEST STATION DESIGN	I	TITLE	1% Des	AEP Flood sign Scenar	Level io	I Impact	t			







COORDINATE SYSTEM Datum: GDA94 Projection: MGA Zone 56			DRAWING	NO.	A09		REVISIC	N IDC		STATUS	STAGE 2
PAGE SIZE A3			CREATED	BY	M.HARTY		DATE	16/10/201	19		
PROJECT NO. 30012631	PROJECT TITLE CROWS NEST STATION DES	IGN	TITLE	1% / Des	AEP Flood ign Scena	Veloc rio	ity Imp	act			





## Appendix B

**Proposed OSD Catchment Plan (Revised)** 

© Sydney Metro 2020

Page 50 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -Appendix G: Flood Assessment and Stormwater Management Plan





## Appendix C

**Crows Nest DRAINS Data (Revised)** 

© Sydney Metro 2020

Page 51 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -Appendix G: Flood Assessment and Stormwater Management Plan

PROJECT: C	CROWS NEST STATION OSD
DRAINS File Path: \	\\AUSYFSV001\Projects Disk 04\$\30012631 – Crows Nest Station Design\110_Detailed Design\110.93 Drainage\01 Drainage Models\OSD Modelling\Existing Site Runoff.drn
DRAINS Version: 2	2018.06
Modeller's Name: P	Pulith Vidanapathirana
Description: EX	EXISTING SITE RUNOFF

## DRAINS DATA

PIT / NODE DETAILS			Version 13			
Name	Туре	Base	x	у	id	Inflow
		Inflow				Hydrograp
		(cu.m/s)				
N1	Node	0	345.255	-202.315	6	No
N3	Node	0	349.868	-273.913	12	No
N4	Node	0	539.554	-259.044	14	No
N5	Node	0	357.102	-340.625	18	No
N6	Node	0	538.751	-321.737	20	No
N11614	Node	0	537.384	-190.162	24590	No

### SUB-CATCHMENT DETAILS

Name	Pit or	Total	Paved	Grass	Supp	Paved	Grass	Supp	Rainfall
	Node	Area	Area	Area	Area	Time	Time	Time	Multiplier
		(ha)	%	%	%	(min)	(min)	(min)	
Exist Site A Building	N1	0.3879	100	0	0	5	10	0	1
Exist Site B Building	N3	0.1872	100	0	0	5	10	0	1
Exist Site C Building	N5	0.0607	100	0	0	5	10	0	1

### OVERFLOW ROUTE DETAILS

Name	From	То	Travel	Safe Depth	SafeDepth	Safe	Bed	D/S Area	id
			Time	Major Stor	Minor Stor	DxV	Slope	Contributir	ng
			(min)	(m)	(m)	(sq.m/sec)	(%)	%	
OF1	N1	N11614	0.1	0.3	0.15	0.4	1	0	7
OF3	N3	N4	0.1	0.3	0.15	0.4	1	0	13
OF5	N5	N6	0.1	0.3	0.15	0.4	1	0	19

This model has no pipes with non-return valves

### DRAINS RESULTS DESIGN STORM:

SIGN STORM: 0.2EY STORM (5YR ARI)

#### SUB-CATCHMENT DETAILS

Name	Max	Paved	Grassed	Paved	Grassed	Supp.	Due to Storm	
	Flow Q	Max Q	Max Q	Тс	Тс	Тс		
	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)		
Exist Site A Building	0.151	0.151	0	5	10	0	0.2EY AEP, 5 min burst	t, Storm 1
Exist Site B Building	0.073	0.073	0	5	10	0	0.2EY AEP, 5 min burst	t, Storm 1
Exist Site C Building	0.024	0.024	0	5	10	0	0.2EY AEP, 5 min burst	t, Storm 1

### OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm	
OF1	0.151	0.151	0.908	0.061	0.05	4	0.83	0.2EY AEP, 5 min burst	, Storm 1
OF3	0.073	0.073	0.908	0.044	0.03	4	0.63	0.2EY AEP, 5 min burst	, Storm 1
OF5	0.024	0.024	0.908	0.03	0.01	4	0.39	0.2EY AEP, 5 min burst	, Storm 1

Run Log for temp existing\_.drn run at 19:14:40 on 25/10/2019

Flows were safe in all overflow routes.

 DRAINS File Path:
 \\AUSYFSV001\Projects Disk 04\$\30012631 - Crows Nest Station Design\110\_Detailed Design\110.93 Drainage\01 Drainage Models\OSD Modelling\Proposed OSD Detention.drn

 DRAINS Version:
 2018.06

Modeller's Name: Pulith Vidanapathirana

Description: PROPOSED OSD DETENTION MODELLING

### DRAINS DATA

PIT / NODE DET	AILS		Version 13						
Name	Туре	Surface	Base	х	у	Bolt-down	id	Part Full	Inflow
		Elev (m)	Inflow			lid		Shock Loss	Hydrograp
			(cu.m/s)						
N425396	Node	90	0	760.332	-183.192		2599217		No
N1316	Node		0	656.937	-186.123		2665		No
N1318	Node	90	0	783.99	-195.153		2670		No
N4661	Node		0	659.565	-362.576		9636		No
N4689	Node	100	0	781.198	-367.925		9693		No
N4751	Node		0	841.387	-402.112		9833		No
N4766	Node		0	869.016	-402.95		9862		No
N5116	Node		0	703.52	-569.794		10598		No
N514942	Node	100	0	822.409	-567.608		4150843		No
N7398	Node		0	661.891	-236.059		15362		No
N7400	Node		0	673.715	-428.569		15373		No
N7402	Node		0	798.486	-592.082		15384		No
N7403	Node	100	0	858.132	-567.05		15388		No
N232840	Node	90	0	830.27	-202.801		555802		No
N425369	Node		0	659.798	-201.639		2599148		No
N425393	Node	90	0	761.037	-196.588		2599214		No
N425376	Node		0	660.728	-215.128		2599165		No
N425398	Node	90	0	760.706	-210.858		2599219		No
N483608	Node		0	659.314	-387.042		3630356		No
N483815	Node	100	0	778.872	-392.623		3630874		No
N553646	Node		0	858.243	-204.389		4823072		No

### DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Outlet Type	Dia(mm)	Centre RL	x	У	HED	id
DetOSDA1	100	14	Orifice	130	100	728.472	-182.639	No	2660
	103	14							
DetB1	100	14	Orifice	110	100	737.708	-366.297	No	9650
	103	14							
DetC1	100	0	Orifice	75	100	774.221	-568.398	No	10626
	103	35							
DetOSDA2	100	14	Orifice	130	100	730.266	-196.755	No	2599150
	103	14							
DetOSDA3	100	14	Orifice	130	100	730.033	-210.476	No	2599169
	103	14							
DetB2	100	14	Orifice	110	100	736.34	-391.73	No	3630562
	103	14							

### SUB-CATCHMENT DETAILS

	1									
Name	Pit or	Total	Paved	Grass	Supp	Paved	Grass	Supp	Lag Time	Rainfall
	Node	Area	Area	Area	Area	Time	Time	Time	or Factor	Multiplier
		(ha)	%	%	%	(min)	(min)	(min)		
OSD Site A1 Roof	N1316	0.1153	100	0	0	5	10	0	0	1
OSD Site B1 Roof	N4661	0.0765	100	0	0	5	10	0	0	1
OSD Site C Roof	N5116	0.0535	100	0	0	5	10	0	0	1
Site A Pavement	N7398	0.0496	100	0	0	5	10	0	0	1
Site B Pavement	N7400	0.0276	100	0	0	5	10	0	0	1
Site C Pavement	N7402	0.0072	100	0	0	5	10	0	0	1
OSD Site A2 Roof	N425369	0.1069	100	0	0	5	10	0	0	1
OSD Site A3 Roof	N425376	0.1168	100	0	0	5	10	0	0	1
OSD Site B2 Roof	N483608	0.0831	100	0	0	5	10	0	0	1

### PIPE DETAILS

Name	From	То	Length	U/S IL	D/S IL	Slope	Туре	Dia	I.D.	Rough	Pipe Is	No. Pipes	Chg From
			(m)	(m)	(m)	(%)		(mm)	(mm)				
Pipe211	DetOSDA1	N425396	10	100	99.95	0.5	uPVC, not i	150	154	0.012	NewFixed	1	N425396
P782	DetB1	N4689	10	100	99.95	0.5	uPVC, not i	150	154	0.012	NewFixed	1	N4689
P882	DetC1	N514942	10	100	90	100	uPVC, not i	. 225	242	0.012	NewFixed	1	N514942
P68931	DetOSDA2	N425393	10	100	99.95	0.5	uPVC, not	150	154	0.012	NewFixed	1	N425393
P68949	DetOSDA3	N425398	10	100	99.95	0.5	uPVC, not i	150	154	0.012	NewFixed	1	N425398
P81089	DetB2	N483815	10	100	99.95	0.5	uPVC. not i	150	154	0.012	NewFixed	1	N483815

### OVERFLOW ROUTE DETAILS

Name	From	То	Travel	Safe Depth	SafeDepth	Safe	Bed	D/S Area		id
			Time	Major Stor	Minor Stor	DxV	Slope	Contributir	ng	
			(min)	(m)	(m)	(sq.m/sec)	(%)	%		
OF258718	N425396	N1318	0.1	0.3	0.15	0.4	1	100		2599238
OF599	N1316	DetOSDA1	0.1	0.3	0.15	0.4	1	0		2664
OF1327	N1318	N232840	0.1	0.3	0.15	0.4	1	100		6023
OF2282	N4661	DetB1	0.1	0.3	0.15	0.4	1	0		9664
OF2313	N4689	N4751	0.1	0.3	0.15	0.4	1	0		9800
OF2346	N4751	N4766	0.1	0.3	0.15	0.4	1	0		9847
OF2552	N5116	DetC1	0.1	0.3	0.15	0.4	1	0		10612
OF3805	N514942	N7403	0.1	0.3	0.15	0.4	1	0		15387
OF3789	N7398	N232840	0.1	0.3	0.15	0.4	1	100		15361
OF3795	N7400	N4751	0.1	0.3	0.15	0.4	1	0		15369
OF3799	N7402	N514942	0.1	0.3	0.15	0.4	1	0		15378
OF338834	N232840	N553646	0.1	0.3	0.15	0.4	1	0		4822969
OF258689	N425369	DetOSDA2	0.1	0.3	0.15	0.4	1	0		2599146
OF258713	N425393	N1318	0.1	0.3	0.15	0.4	1	100		2599233
OF258693	N425376	DetOSDA3	0.1	0.3	0.15	0.4	1	0		2599167
OF258703	N425398	N1318	0.1	0.3	0.15	0.4	1	100		2599222
OF295082	N483608	DetB2	0.1	0.3	0.15	0.4	1	0		3630459
OF295186	N483815	N4751	0.1	0.3	0.15	0.4	1	0		3630771

This model has no pipes with non-return valves

### DRAINS RESULTS

DESIGN STORM:

PIT / NODE DETAILS		
Name	Max HGL	Max Surface
		Flow Arriving
		(cu.m/s)
N425396	90	0
N4689	100.09	0
N514942	90.03	0.007
N425393	90	0
N425398	90	0
N483815	100.09	0

1% AEP STORM

### SUB-CATCHMENT DETAILS

									1
Name	Max	Paved	Grassed	Paved	Grassed	Supp.	Due to Sto	rm	
	Flow Q	Max Q	Max Q	Тс	Тс	Тс			
	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)			
OSD Site A1 Roof	0.098	0.098	0	5	10	0	1% AEP, 5 ı	min burst, S	torm 1
OSD Site B1 Roof	0.065	0.065	0	5	10	0	1% AEP, 5 ı	min burst, S	torm 1
OSD Site C Roof	0.045	0.045	0	5	10	0	1% AEP, 5 I	min burst, S	torm 1
Site A Pavement	0.042	0.042	0	5	10	0	1% AEP, 5 I	min burst, S	torm 1
Site B Pavement	0.023	0.023	0	5	10	0	1% AEP, 5 ı	min burst, S	torm 1
Site C Pavement	0.006	0.006	0	5	10	0	1% AEP, 5 ı	min burst, S	torm 1
OSD Site A2 Roof	0.091	0.091	0	5	10	0	1% AEP, 5 ı	min burst, S	torm 1
OSD Site A3 Roof	0.099	0.099	0	5	10	0	1% AEP, 5 ı	min burst, S	torm 1
OSD Site B2 Roof	0.071	0.071	0	5	10	0	1% AEP, 5 I	min burst, S	torm 1

Version 8

PIPE DETAILS	PIPE DETAILS										
Name	Max Q	Max V	Max U/S	Max D/S	Due to Sto	rm					
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)							
Pipe211	0.043	2.3	100.154	100.104	1% AEP, 20	min burst, St	orm 2				
P782	0.027	1.52	101.199	100.093	1% AEP, 20	min burst, St	orm 8				
P882	0.017	5.75	100.107	90.028	1% AEP, 20	min burst, St	orm 2				
P68931	0.041	2.18	100.154	100.104	1% AEP, 20	min burst, St	orm 2				
P68949	0.043	2.32	100.154	100.104	1% AEP, 20	min burst, St	orm 2				
P81089	0.029	1.59	101.339	100.095	1% AEP, 20	min burst, St	orm 8				

#### OVERFLOW ROUTE DETAILS

									(
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm	
OF258718	0.043	0.043	1.479	0.036	0.02	4	0.51	1% AEP, 20 min burst,	Storm 2
OF599	0.098	0.098	1.479	0.05	0.04	4	0.7	1% AEP, 5 min burst, S	torm 1
OF1327	0.127	0.127	1.201	0.111	0.11	2.83	1.01	1% AEP, 20 min burst,	Storm 2
OF2282	0.065	0.065	1.479	0.042	0.03	4	0.6	1% AEP, 5 min burst, S	torm 1
OF2313	0.027	0.027	1.201	0.068	0.05	1.39	0.79	1% AEP, 20 min burst,	Storm 8
OF2346	0.067	0.067	1.201	0.09	0.08	2.14	0.9	1% AEP, 20 min burst,	Storm 10
OF2552	0.045	0.045	1.479	0.037	0.02	4	0.52	1% AEP, 5 min burst, S	torm 1
OF3805	0.021	0.021	1.479	0.029	0.01	4	0.38	1% AEP, 10 min burst,	Storm 7
OF3789	0.042	0.042	1.479	0.036	0.02	4	0.5	1% AEP, 5 min burst, S	torm 1
OF3795	0.023	0.023	1.479	0.03	0.01	4	0.39	1% AEP, 5 min burst, S	torm 1
OF3799	0.006	0.006	1.479	0.021	0.01	4	0.25	1% AEP, 5 min burst, S	torm 1
OF338834	0.14	0.14	1.201	0.114	0.12	2.94	1.03	1% AEP, 20 min burst,	Storm 10
OF258689	0.091	0.091	1.479	0.048	0.03	4	0.69	1% AEP, 5 min burst, S	torm 1
OF258713	0.041	0.041	1.479	0.035	0.02	4	0.51	1% AEP, 20 min burst,	Storm 2
OF258693	0.099	0.099	1.479	0.05	0.04	4	0.71	1% AEP, 5 min burst, S	torm 1
OF258703	0.043	0.043	1.479	0.036	0.02	4	0.51	1% AEP, 20 min burst,	Storm 2
OF295082	0.071	0.071	1.479	0.044	0.03	4	0.61	1% AEP, 5 min burst, S	torm 1
OF295186	0.029	0.029	1.201	0.069	0.05	1.42	0.8	1% AEP, 20 min burst,	Storm 8

#### DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q	Max Q	Max Q
			Total	Low Level	High Level
DetOSDA1	102.09	29.2	0.043	0.043	0
DetB1	101.45	20.3	0.027	0.027	0
DetC1	102.15	12.9	0.017	0.017	0
DetOSDA2	101.9	26.6	0.041	0.041	0
DetOSDA3	102.12	29.7	0.043	0.043	0
DetB2	101.63	22.8	0.029	0.029	0

Flows were safe in all overflow routes.



# DRAINS SETUP -EXISTING SITE RUNOFF (5YR ARI)



# DRAINS SETUP -PROPOSED OSD DETENTION MODELLING (100YR ARI)



## Appendix D

**MUSIC Data (Revised)** 

© Sydney Metro 2020

Page 52 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -Appendix G: Flood Assessment and Stormwater Management Plan

Date	Inflow cu.m/sec	Inflow [TSS] (mg/L)	Inflow [TP] (mg/L)	Inflow [TN] (mg/L)	Inflow TSS kg/Day	Inflow TP kg/Day	Inflow TN kg/Day	Inflow GP kg/Day
1/01/2015	0.00023927	42.72434288	0.16344725	1.48769295	0.88322216	0.00337888	0.03075444	0.17193528
2/01/2015	0.00064391	38.87104132	0.13803939	1.666087	2.16255865	0.00767971	0.09269139	0.25685235
3/01/2015	0.00001923	34,88495004	0.12521809	1.8455066	0.05795563	0.00020803	0.00306601	0
4/01/2015	0.00050208	11.00133001	0 18510057	1 64634063	1 94961205	0.00803355	0.07141853	0 2208/1201
4/01/2013	0.00030208	44.94272209	0.10319037	1.04034903	1.94901203	0.00803333	0.07141833	0.23964391
5/01/2015	0.00028655	22.48098854	0.13012/32	1.499/965	0.55657958	0.00322166	0.03/13165	0.14215284
6/01/2015	0	-9999	-9999	-9999	0	0	0	0
7/01/2015	0.00000952	45.80972218	0.1516813	1.55745046	0.0376794	0.00012476	0.00128103	0
8/01/2015	0.0000447	23.3923524	0.13876978	1.58459482	0.09034911	0.00053598	0.00612024	0.00385696
9/01/2015	0	-9999	-9999	-9999	0	0	0	0
10/01/2015	0.000/1508	29 003399/15	0 1/63593	1 30757710	1 1296/1511	0.00570051	0.05///3383	0 19778125
10/01/2015	0.0004308	29.00339943	0.1403593	1.33737713	1.12904511	0.00570051	0.03443383	0.19778123
11/01/2015	0	-9999	-9999	-9999	0	0	0	0
12/01/2015	0	-9999	-9999	-9999	0	0	0	0
13/01/2015	0	-9999	-9999	-9999	0	0	0	0
14/01/2015	0	-9999	-9999	-9999	0	0	0	0
15/01/2015	0	-9999	-9999	-9999	0	0	0	0
16/01/2015	0	0000	0000	0000	0	0	0	0
10/01/2015	0	-9999	-9999	-9999	0	0	0	0
17/01/2015	0	-9999	-9999	-9999	0	0	0	0
18/01/2015	0	-9999	-9999	-9999	0	0	0	0
19/01/2015	0	-9999	-9999	-9999	0	0	0	0
20/01/2015	0	-9999	-9999	-9999	0	0	0	0
21/01/2015	0.00010209	29 97/6/796	0 12301707	1 /0368115	0 2644022	0.00109306	0 01317555	0.06691/18
21/01/2015	0.00010209	29.97404790	0.12591797	1.43308113	0.2044022	0.00109300	0.01317333	0.00091418
22/01/2015	0.00151649	34.27951307	0.13544092	1.4325445	4.49147517	0.01774615	0.18769923	0.29705529
23/01/2015	0.00000118	4.91685825	0.07399411	1.02927757	0.00050004	0.00000753	0.00010468	0
24/01/2015	0.00018766	29.74305226	0.19414601	1.31652484	0.48224089	0.0031478	0.02134556	0.11907145
25/01/2015	0	-9999	-9999	-9999	0	0	0	0
26/01/2015	0.00223648	32.20147809	0.13568136	1.48599709	6.22235984	0.026218	0.28714237	0.33499332
27/01/2015	0.00264674	31 66113621	0 13375204	1 46232842	7 24020835	0.03058616	0 33440248	0 34428388
28/01/2015	0.00204074	10 6644745	0.13373204	1 10102020	0.24020033	0.00160050	0.0000525	0.02564504
20/01/2015	0.0002056	19.0041/15	0.09460853	1.18193858	0.34930439	0.00168058	0.02099535	0.03561584
29/01/2015	0	-9999	-9999	-9999	0	0	0	0
30/01/2015	0	-9999	-9999	-9999	0	0	0	0
31/01/2015	0	-9999	-9999	-9999	0	0	0	0
1/02/2015	0	-9999	-9999	-9999	0	0	0	0
2/02/2015	0	_0000	_0000	_0000_	0	0	0	0
2/02/2015	0	-9999	-9999	-9999	0	0	0	0
3/02/2015	0	-9999	-9999	-9999	0	0	0	0
4/02/2015	0	-9999	-9999	-9999	0	0	0	0
5/02/2015	0	-9999	-9999	-9999	0	0	0	0
6/02/2015	0	-9999	-9999	-9999	0	0	0	0
7/02/2015	0.00010176	26 34284211	0 12582503	1 42058296	0 23161173	0.00110628	0.01249006	0.0666948
9/02/2015 8/02/2015	0.00010170	20.34204211	0.12302303	0.04472725	0.201011/3	0.00110020	0.0001105	0.0000048
8/02/2015	0.0000013	5.04239885	0.07008135	0.94473735	0.00003847	0.0000089	0.00001195	0
9/02/2015	0	-9999	-9999	-9999	0	0	0	0
10/02/2015	0	-9999	-9999	-9999	0	0	0	0
11/02/2015	0	-9999	-9999	-9999	0	0	0	0
12/02/2015	0	-9999	-9999	-9999	0	0	0	0
13/02/2015	0	-9999-	_9999_	_9999_	0	0	0	0
14/02/2015	0	0000	0000	0000	0	0	0	0
14/02/2015	0	-9999	-9999	-9999	0	0	0	0
15/02/2015	0.00201389	44.04615252	0.13329646	1.43005922	7.6640301	0.02319358	0.24883029	0.32801054
16/02/2015	0.00005101	3.86385714	0.07150262	0.98974065	0.01703047	0.00031516	0.00436242	0
17/02/2015	0.00008659	50.23484833	0.16871001	1.65538848	0.37583001	0.0012622	0.01238472	0.09372125
18/02/2015	0.00849501	30.47717849	0.14165866	1.50883248	22.36929933	0.10397304	1.10743602	0.44646986
19/02/2015	0.00035681	24,03617733	0,11860429	1.34631794	0.74099342	0.00365636	0.04150463	0,1529109
20/02/2015			_0000	0000_				0
20/02/2015	0.00042652	24 20405264	0 420 420 6	1 40752025	0.40464625	0.001530.02	0.01766444	0.00500001
21/02/2015	0.00013652	34.30195364	0.13042163	1.49/52925	0.40461635	0.00153842	0.01766444	0.09539021
22/02/2015	0.00000619	5.57325305	0.07491707	1.09241639	0.00297967	0.00004005	0.00058405	0
23/02/2015	0	-9999	-9999	-9999	0	0	0	0
24/02/2015	0	-9999	-9999	-9999	0	0	0	0
25/02/2015	0	-9999	-9999	-9999	0	0	0	0
26/02/2015	n	_9999	-9999	_9999	n	n 0	n 0	0
27/02/2015	0 0004251	26 07/122050	0 12/000	1 56776713	0 00073350	0 00403000		0 10077056
27/02/2015	0.0004231	20.37422039	0.13422007	1.30770713	0.33072238	0.00492999	0.03/361/1	0.1307/030
28/02/2015	0.00005099	4.65385678	0.07397508	1.04982509	0.02050328	0.00032591	0.00462517	0
1/03/2015	0.00005049	43.45644572	0.14458854	1.55000013	0.18956306	0.00063072	0.00676132	0.0116522
2/03/2015	0.00000287	4.71661873	0.0742033	1.05447174	0.00116986	0.0000184	0.00026154	0
3/03/2015	0.00040923	47.08620939	0.13413333	1.4429543	1.66484269	0.0047426	0.05101901	0.18572968
4/03/2015	0.00093549	29,21620561	0 13639742	1 49107354	2.36142676	0.01102445	0.12051739	0.25980634
5/02/2015	0 00004702	5 12020301	0.07/26610	1 0/252767	0 0200292070	0.002202440	0.00433053	0.2000004
6/02/2015	0.0004702	5.12355117	0.07430010	1.04333707	0.02003000	0.00030212	0.00423935	0
0/03/2015	0	-9999	-9999	-9999	0	0	0	0
7/03/2015	0	-9999	-9999	-9999	0	0	0	0
8/03/2015	0	-9999	-9999	-9999	0	0	0	0
9/03/2015	0	-9999	-9999	-9999	0	0	0	0
10/03/2015	n	-9999	-9999	_9999	n	0	0	0
11/02/2015	0.00010161	27 10104504	0 12420214	1 20447652	0 4500000		0.0320963	0 12062220
12/02/2015	0.00019101	27.10104304	0.15420214	1.5944/053	0.45000996	0.002221/9	0.0250803	0.12002238
12/03/2015	0.00001441	25.46089218	0.17202822	1.55214773	0.03169238	0.00021413	0.00193203	0
13/03/2015	0	-9999	-9999	-9999	0	0	0	0
14/03/2015	0	-9999	-9999	-9999	0	0	0	0
15/03/2015	0	-9999	-9999	-9999	0	0	0	0
16/03/2015		_9090	_9090	_9999	n			0
17/02/2015		44.04500000	0 4 5 4 0 4 5 2 0	1 57400000			0 40022240	0.24620265
1//03/2015	0.00080364	41.94599682	0.15181539	1.57460612	2.91250474	0.01054125	0.10933219	0.24638365
18/03/2015	0.00062224	25.058302	0.15676957	1.43435146	1.34717568	0.00842819	0.0771131	0.21928907
19/03/2015	0.0000082	3.92024684	0.07212744	0.98041345	0.00027752	0.00000511	0.0000694	0

Date	Inflow cu.m/sec	Inflow [TSS] (mg/L)	Inflow [TP] (mg/L)	Inflow [TN] (mg/L)	Inflow TSS kg/Day	Inflow TP kg/Day	Inflow TN kg/Day	Inflow GP kg/Day
20/03/2015	0.00006344	30.36794937	0.11085458	1.46204007	0.16645817	0.00060764	0.00801399	0.02639167
21/03/2015	0	2.36945785	0.05587935	0.86637081	0.0000003	0	0.0000001	0
22/03/2015	0	-9999	-9999	-9999	0	0	0	0
24/03/2015	0	-9999	-9999	-9999	0	0	0	0
25/03/2015	0.00079164	27.33696195	0.1429405	1.41049065	1.86978665	0.00977681	0.09647439	0.24221478
26/03/2015	0.00092829	33.53994363	0.13900235	1.52341427	2.69003752	0.01114854	0.12218391	0.2550818
27/03/2015	0.00038711	28.50081387	0.1411139	1.43007283	0.95325664	0.00471979	0.04783114	0.18071286
28/03/2015	0.00111683	36.36624074	0.12561178	1.46472625	3.50914173	0.01212084	0.14133801	0.27544205
29/03/2015	0.00202786	29.45918277	0.13002345	1.46270879	5.1614635	0.02278106	0.25627724	0.32000207
30/03/2015	0.00006158	20.06997116	0.101734	1.2679459	0.10677402	0.00054123	0.00674558	0
31/03/2015	0	-9999	-9999	-9999	0	0	0	0
1/04/2015	0	-9999	-9999	-9999	0	0	0	0
2/04/2015	0.00061553	25.9584801	0.142/25/4	1.44388444	1.38052448	0.00759044	0.07678869	0.22017739
3/04/2015	0.00055508	29.06972065	_0000	1.40623906	0.85714018	0.0037213	0.04040856	0.10775075
5/04/2015	0	-9999	-9999	-9999	0	0	0	0
6/04/2015	0	-9999	-9999	-9999	0	0	0	0
7/04/2015	0	-9999	-9999	-9999	0	0	0	0
8/04/2015	0	-9999	-9999	-9999	0	0	0	0
9/04/2015	0	-9999	-9999	-9999	0	0	0	0
10/04/2015	0	-9999	-9999	-9999	0	0	0	0
11/04/2015	0.00049318	26.33389674	0.14363528	1.4900447	1.12210098	0.00612037	0.06349158	0.20137146
12/04/2015	0.0000001	2.48533343	0.0675196	0.91248001	0.00000183	0.0000005	0.0000067	0
13/04/2015	0	-9999	-9999	-9999	0	0	0	0
14/04/2015	0	-9999	-9999	-9999	0	0	0	0
15/04/2015	0	-9999	-9999	-9999	0	0	0	0
16/04/2015	0 00020415	-9999	-9999	-9999	0 29492591	0 00240278	0 02626977	0 1294709
17/04/2015	0.00020413	3 92543687	0.1302771	0.99177513	0.38483381	0.00240378	0.02030877	0.1284798
19/04/2015	0.0000021	-9999	_9999	-9999	0.00210002	0.00003504	0.00033203	0
20/04/2015	0	-9999	-9999	-9999	0	0	0	0
21/04/2015	0	-9999	-9999	-9999	0	0	0	0
22/04/2015	0	-9999	-9999	-9999	0	0	0	0
23/04/2015	0	-9999	-9999	-9999	0	0	0	0
24/04/2015	0.00001803	30.48988265	0.14484933	1.47153824	0.04749414	0.00022563	0.00229222	0
25/04/2015	0.00050931	25.51241642	0.13951667	1.4969476	1.12265376	0.00613932	0.065872	0.20427463
26/04/2015	0.0000084	3.4392792	0.07135472	0.96466575	0.00024832	0.00000515	0.00006965	0
27/04/2015	0	-9999	-9999	-9999	0	0	0	0
28/04/2015	0	-9999	-9999	-9999	0	0	0	0
29/04/2015	0	-9999	-9999	-9999	0	0	0	0
1/05/2015	0	-9999	-9999	-9999	0	0	0	0
2/05/2015	0	-9999	_9999	-9999	0	0	0	0
3/05/2015	0	-9999	-9999	-9999	0	0	0	0
4/05/2015	0	-9999	-9999	-9999	0	0	0	0
5/05/2015	0	-9999	-9999	-9999	0	0	0	0
6/05/2015	0	-9999	-9999	-9999	0	0	0	0
7/05/2015	0.00044886	34.44483435	0.13254025	1.44262275	1.33583611	0.00514016	0.05594765	0.19337657
8/05/2015	0.00022129	29.91361871	0.13860047	1.4137358	0.57194462	0.00265002	0.02703045	0.13189193
9/05/2015	0.00011405	44.76197562	0.11248673	1.6556903	0.44109032	0.00110846	0.01631539	0.07894397
10/05/2015	0.00000342	3.88291986	0.07256825	0.98297564	0.00114624	0.00002142	0.00029017	0
11/05/2015	0	-9999	-9999	-9999	0	0	0	0
12/05/2015	0 00010202	-9999	-9999	-9999	0 2710540	0.00121962	0.01420402	0 08720202
14/05/2015	0.00056103	32 06693122	0.12333755	1 41695626	1 55438402	0.00131002	0.06868428	0.20814145
15/05/2015	0.00000103	-9999	-9999	-9999	0	0	0.00000428	0.20014145
16/05/2015	0	-9999	-9999	-9999	0	0	0	0
17/05/2015	0.00054549	43.90335124	0.13914043	1.4741331	2.06916859	0.0065577	0.06947602	0.21089613
18/05/2015	0.00015539	35.56739682	0.13116553	1.31272283	0.47752507	0.00176102	0.01762451	0.09926792
19/05/2015	0.00030752	31.87414502	0.13275232	1.46902198	0.84687405	0.00352714	0.0390309	0.16758099
20/05/2015	0.00002599	4.9838271	0.07438412	1.02615867	0.01119345	0.00016706	0.00230471	0
21/05/2015	0.00002464	27.31772915	0.13007068	1.46156869	0.05816093	0.00027693	0.00311176	0
22/05/2015	0	-9999	-9999	-9999	0	0	0	0
23/05/2015	0	-9999	-9999	-9999	0	0	0	0
24/05/2015	0	-9999	-9999	-9999	0	0	0	0
25/05/2015	0	-9999	-9999	-9999		0	0	0
20/03/2013	0	-9999	-9999	-9999				0
28/05/2015	0	_9999	_9999 _9999		0	0	0	0
29/05/2015	0	-9999	-9999	-9999	0	0	0	0
30/05/2015	0.00052339	33.97651671	0.13222197	1.4943422	1.53644455	0.00597918	0.06757532	0.20918345
31/05/2015	0.00010758	37.72852476	0.15527316	1.46790895	0.35068458	0.00144326	0.01364413	0.09898077
1/06/2015	0.00143273	29.96630533	0.13152258	1.46278033	3.70946794	0.01628091	0.1810746	0.29098476
2/06/2015	0.00133369	35.33306502	0.12704187	1.42847061	4.07144592	0.0146391	0.16460335	0.28393951
3/06/2015	0.00013475	27.57686511	0.13648679	1.43678624	0.32105792	0.00158902	0.01672749	0.08946332
4/06/2015	0.00000439	4.37611371	0.07269968	0.99136772	0.00166019	0.00002758	0.0003761	0
5/06/2015	0	-9999	-9999	-9999	0	0	0	0

Date	Inflow cu.m/sec	Inflow [TSS] (mg/L)	Inflow [TP] (mg/L)	Inflow [TN] (mg/L)	Inflow TSS kg/Day	Inflow TP kg/Day	Inflow TN kg/Day	Inflow GP kg/Day
7/06/2015	0 00025712	-9999	-9999	-9999	0 68593955	0.00260344	0 0327/19/15	0 1//591712
8/06/2015	0.00023712	3 62994715	0.07136384	0 96659321	0.08595955	0.00200344	0.00274945	0.14551712
9/06/2015	0	-9999	-9999	-9999	0.000103	0	0.00001520	0
10/06/2015	0	-9999	-9999	-9999	0	0	0	0
11/06/2015	0	-9999	-9999	-9999	0	0	0	0
12/06/2015	0	-9999	-9999	-9999	0	0	0	0
13/06/2015	0.00023833	28.29354601	0.12948255	1.54147628	0.58262078	0.0026663	0.03174208	0.13917108
14/06/2015	0.0000001	2.46335281	0.06836984	0.91333963	0.00000261	0.0000007	0.0000097	0
15/06/2015	0	-9999	-9999	-9999	0	0	0	0
16/06/2015	0	-9999	-9999	-9999	0	0	0	0
18/06/2015	0	-9999	-9999	-9999	0	0	0	0
19/06/2015	0	-9999	-9999	-9999	0	0	0	0
20/06/2015	0	-9999	-9999	-9999	0	0	0	0
21/06/2015	0	-9999	-9999	-9999	0	0	0	0
22/06/2015	0	-9999	-9999	-9999	0	0	0	0
23/06/2015	0.00038994	33.43256837	0.13189329	1.39627767	1.12637308	0.0044436	0.04704184	0.18133564
24/06/2015	0.00000127	3.17574218	0.07063318	0.95009282	0.00034791	0.0000774	0.00010409	0
25/06/2015	0.00046642	30.87716399	0.12697969	1.45825061	1.24431152	0.00511712	0.0587657	0.19638313
26/06/2015	0.00001872	37.23386382	0.14951049	1.40948656	0.06022824	0.00024184	0.00227994	0.01176598
28/06/2015	0.00167858	32,43572727	0.13740303	1.43187724	4,70411822	0.01875058	0.2076636	0.30660762
29/06/2015	0.00026642	26.36471072	0.13654332	1.40981179	0.60688635	0.00314308	0.0324523	0.14739068
30/06/2015	0.00000397	4.5761631	0.0732742	1.01388178	0.00157066	0.00002515	0.00034799	0
1/07/2015	0.00003472	23.95557946	0.1309354	1.44301785	0.07187198	0.00039283	0.00432937	0
2/07/2015	0	-9999	-9999	-9999	0	0	0	0
3/07/2015	0	-9999	-9999	-9999	0	0	0	0
4/07/2015	0	-9999	-9999	-9999	0	0	0	0
5/07/2015	0	-9999	-9999	-9999	0	0	0	0
7/07/2015	0	-9999	-9999	-9999	0	0	0	0
8/07/2015	0.00000922	40.79778687	0.15604292	1.57779215	0.03251537	0.00012436	0.00125748	0
9/07/2015	0.00083642	27.8781975	0.13061173	1.42395326	2.01466558	0.00943888	0.10290442	0.2459188
10/07/2015	0.0000389	3.80489405	0.07204269	0.97918797	0.00128007	0.00002424	0.00032943	0
11/07/2015	0	-9999	-9999	-9999	0	0	0	0
12/07/2015	0	-9999	-9999	-9999	0	0	0	0
13/07/2015	0	-9999	-9999	-9999	0	0	0	0
14/07/2015	0	-9999	-9999	-9999	0	0	0	0
16/07/2015	0	-9999	-9999	-9999	0	0	0	0
17/07/2015	0	-9999	-9999	-9999	0	0	0	0
18/07/2015	0	-9999	-9999	-9999	0	0	0	0
19/07/2015	0	-9999	-9999	-9999	0	0	0	0
20/07/2015	0.00526072	32.30042904	0.14739889	1.52277909	14.68139185	0.06699666	0.69214302	0.40876034
21/07/2015	0.00404068	32.20572281	0.13269559	1.48191757	11.24348168	0.04632594	0.51735877	0.37686661
22/07/2015	0.00084683	34.59973808	0.12998894	1.42812376	2.53153904	0.00951083	0.10449071	0.24697032
23/07/2015	0	-9999	-9999	-9999	0	0	0	0
25/07/2015	0.00107005	31,13240949	0,12920075	1,43337167	2,87825579	0.01194488	0,13251818	0.26709618
26/07/2015	0.00001392	27.0986962	0.12198276	1.42131792	0.03258772	0.00014669	0.00170922	0
27/07/2015	0.00001776	29.3462969	0.13655629	1.55493721	0.04503988	0.00020958	0.00238647	0
28/07/2015	0	-9999	-9999	-9999	0	0	0	0
29/07/2015	0	-9999	-9999	-9999	0	0	0	0
30/07/2015	0.0000667	34.10760388	0.16590395	1.35783439	0.0196558	0.00009561	0.0007825	0
31/07/2015	0.00000375	5.39446592	0.07517609	1.07195215	0.00174619	0.00002433	0.00034699	0
2/08/2015	0	-9999	-9999	-9999		0	0	0
3/08/2015	0	-9999	-9999 -9999	-9999		0	0 0	0
4/08/2015	0	-9999	-9999	-9999	0	0	0	0
5/08/2015	0	-9999	-9999	-9999	0	0	0	0
6/08/2015	0	-9999	-9999	-9999	0	0	0	0
7/08/2015	0	-9999	-9999	-9999	0	0	0	0
8/08/2015	0.00015353	29.44596353	0.13926674	1.44693327	0.39060042	0.00184737	0.01919356	0.10160506
9/08/2015	0	2.36945776	0.05587935	0.86637086	0.0000031	0.00000001	0.00000011	0
11/08/2015	0	-9999	-9999	-9999	0	0	0	0
12/08/2015		-9999	-9999	-9999				0
13/08/2015	0	_9999	-9999	-9999	0	0	0	0
14/08/2015	0	-9999	-9999	-9999	0	0	0	0
15/08/2015	0	-9999	-9999	-9999	0	0	0	0
16/08/2015	0.00050466	33.58539931	0.1382792	1.43781272	1.46441613	0.00602935	0.0626926	0.20395421
17/08/2015	0.00021697	32.2728074	0.12612471	1.49120504	0.60498507	0.00236433	0.02795408	0.12863995
18/08/2015	0.00063306	33.54406044	0.13289343	1.35551801	1.83474279	0.00726881	0.07414209	0.22222146
19/08/2015	0.0000019	3.74649769	0.07186078	0.97213822	0.00006124	0.00000117	0.00001589	0
20/08/2015	0	-9999	-9999	-9999		0	0	0
22/08/2015	0	-9999	-9999	-9999	0	0	0 0	0

Date	Inflow cu.m/sec	Inflow [TSS] (mg/L)	Inflow [TP] (mg/L)	Inflow [TN] (mg/L)	Inflow TSS kg/Day	Inflow TP kg/Day	Inflow TN kg/Day	Inflow GP kg/Day
23/08/2015	0	-9999	-9999	-9999	0	0	0	0 1152707
24/08/2015	0.0001/99/	29.96970004	0.13503926	1.55012522	0.46601742	0.00209981	0.02410386	0.1153707
25/08/2015	0.000004	4.95419673	0.07464867	1.03785472	0.00017257	0.000028	0.00003015	0
20/08/2015	0 00227624	-9999	-9999	-9999	0.02065700	0,0279026	0 41089540	0 26226126
27/08/2015	0.00327624	1 73255287	0.13334977	1.45154591	9.05065709	0.0078030	0.41086549	0.30330120
29/08/2015	0.00001027	41 84452338	0.07293113	1 43200248	0.00413804	0.00000471	0.000583861	0 04117041
30/08/2015	0.00004713	9 68570513	0.17332513	1 16598599	0.17000584	0.00070913	0.00385801	0.0411/041
31/08/2015	0.00004029	-9999	-9999	-9999	0.03371330	0.00042552	0.00403523	0
1/09/2015	0	-9999	-9999	-9999	0	0	0	0
2/09/2015	0.00001796	32.02615681	0.12620325	1.41598287	0.04970334	0.00019586	0.00219755	0
3/09/2015	0.00004506	39.92738173	0.16813126	1.49755282	0.15543144	0.00065451	0.00582975	0.0048986
4/09/2015	0.00005587	27.79975344	0.10535495	1.53915817	0.13419288	0.00050856	0.00742971	0.02711422
5/09/2015	0.00004105	26.42780147	0.12997842	1.32933666	0.09373752	0.00046102	0.00471506	0
6/09/2015	0	-9999	-9999	-9999	0	0	0	0
7/09/2015	0.00057163	32.97833009	0.12906397	1.5720858	1.62876955	0.00637435	0.07764388	0.22090547
8/09/2015	0.00024209	24.3584655	0.11831095	1.36148854	0.5094986	0.00247467	0.02847784	0.12199371
9/09/2015	0.00376445	31.80656824	0.14170388	1.50526738	10.34502452	0.04608891	0.48958529	0.37729464
10/09/2015	0.00026178	42.51418364	0.15386862	1.56000493	0.96156315	0.00348012	0.03528336	0.14686032
11/09/2015	0	-9999	-9999	-9999	0	0	0	0
12/09/2015	0	-9999	-9999	-9999	0	0	0	0
13/09/2015	0	-9999	-9999	-9999	0	0	0	0
14/09/2015	0	-9999	-9999	-9999	0	0	0	0
15/09/2015	0	-9999	-9999	-9999	0	0	0	0
17/09/2015	0	-9999	-9999	-9999	0	0	0	0
18/00/2015		-9999	-9999	-9999		0		0
19/09/2015	0	-9999	-9999	-9999	0			0
20/09/2015	0	-9999	-9999	-9999	0	0		0
21/09/2015	0	-9999	-9999	-9999	0	0	0	0
22/09/2015	0	-9999	-9999	-9999	0	0	0	0
23/09/2015	0	-9999	-9999	-9999	0	0	0	0
24/09/2015	0	-9999	-9999	-9999	0	0	0	0
25/09/2015	0.00000057	22.68388175	0.12347224	1.56893177	0.00111347	0.0000606	0.00007701	0
26/09/2015	0.000001	4.56372427	0.07430624	1.05080528	0.00003904	0.0000064	0.00000899	0
27/09/2015	0	-9999	-9999	-9999	0	0	0	0
28/09/2015	0	-9999	-9999	-9999	0	0	0	0
29/09/2015	0	-9999	-9999	-9999	0	0	0	0
30/09/2015	0	-9999	-9999	-9999	0	0	0	0
1/10/2015	0	-9999	-9999	-9999	0	0	0	0
2/10/2015	0	-9999	-9999	-9999	0	0	0	0
3/10/2015	0.00132999	28.79261524	0.1408139	1.55495488	3.3085949	0.0161811	0.17868178	0.28669612
4/10/2015	0.00283736	34.24458561	0.13359496	1.54856575	8.39498045	0.03275049	0.37962729	0.35068766
5/10/2015	0.00004375	28.52821543	0.12096012	1.50035774	0.10784221	0.00045725	0.00567164	0
6/10/2015	0.0000625	29.3736472	0.12842506	1.43993454	0.15861069	0.00069346	0.0077753	0.02529192
//10/2015	0.0000923	33.79748198	0.12240323	1.69430046	0.26953208	0.00097616	0.0135119	0.0583004
8/10/2015	0	-9999	-9999	-9999	0	0	0	0
9/10/2015	0	-9999	-9999	-9999	0	0	0	0
11/10/2015	0	-9999	-9999	-9999	0	0	0	0
12/10/2015	0.00029598	32,70317059	0.13608482	1.47022311	0.836311	0.00348007	0.03759769	0.15876334
13/10/2015	0.00000427	3.9169521	0.07231982	1.00413921	0.00144547	0.00002669	0.00037056	0
14/10/2015	0.0001339	35.30616921	0.16054376	1.46570657	0.40846983	0.00185739	0.01695729	0.1096482
15/10/2015	0.00003485	4.95580034	0.07458993	1.05765191	0.01492347	0.00022461	0.00318492	0
16/10/2015	0.00028362	25.76072399	0.12948928	1.47962177	0.63126067	0.00317311	0.03625779	0.15389045
17/10/2015	0	2.48260046	0.06697127	0.91543191	0.00000058	0.0000002	0.00000022	0
18/10/2015	0	-9999	-9999	-9999	0	0	0	0
19/10/2015	0	-9999	-9999	-9999	0	0	0	0
20/10/2015	0.00273677	35.15746405	0.13358342	1.66315496	8.31322536	0.03158672	0.39326448	0.35296803
21/10/2015	0.00209059	31.05309254	0.1313878	1.4185193	5.60901498	0.02373213	0.25622234	0.32286521
22/10/2015	0.0002203	28.8983078	0.11641172	1.50065276	0.55004944	0.00221578	0.02856338	0.10760813
23/10/2015	0.0000029	4.59991821	0.07286637	1.01479717	0.00115097	0.00001823	0.00025392	0
24/10/2015	0	-9999	-9999	-9999	0	0		0
25/10/2015	0	-9999	-9999	-9999		0	0	0
20/10/2015		-9999	-9999	-9999		0		0
28/10/2015	0.00055527	34 26690023	0 154930/18	1 54673174	1 64395161	0.00743278	0.07420432	0.22278521
29/10/2015	0.00011216	11.50811365	0.08921665	1.23914193	0.11152463	0.00086459	0.01200847	0.22270551
30/10/2015	0.00688132	30.03595515	0.1308851	1.5489694	17.8577629	0.07781724	0.92093386	0.43026207
31/10/2015	0.00052951	29.14556619	0.13228738	1.45285433	1.33339564	0.00605208	0.06646739	0.20895
1/11/2015	0.0000006	2.87542601	0.06770585	0.9347885	0.00001466	0.00000035	0.00000476	0
2/11/2015	0	-9999	-9999	-9999	0	0	0	0
3/11/2015	0	-9999	-9999	-9999	0	0	0	0
4/11/2015	0.00178033	39.4021962	0.14531041	1.53749266	6.06086037	0.0223517	0.23649769	0.31456631
5/11/2015	0.0000006	2.71239169	0.06620737	0.92520642	0.00001357	0.0000033	0.00000463	0
6/11/2015	0	-9999	-9999	-9999	0	0	0	0
7/11/2015	0	-9999	-9999	-9999	0	0	0	0
8/11/2015	0	-9999	-9999	-9999	0	0	0	0

9/11/2015         0.0014561         30.512202         0.0278824         1.44221009         3.825065         0.00001187         0.00001187           0.11/2015         0.00005201         37.6421337         0.1278422         1.3515888         0.0005621         0.0005474         0.00001475         0.20014754           1.11/12/1015         0.00005701         27.3460974         0.1385860         1.47627262         1.57736786         0.0054971         0.03341673         0.03341673         0.03341673         0.03341673         0.03341673         0.03341673         0.03341673         0.03341673         0.03341673         0.03341673         0.0000751         0.0000751         0.0000075         0.0000771         0.0000001         0.0000071         0.0000071	Date	Inflow cu.m/sec	Inflow [TSS] (mg/L)	Inflow [TP] (mg/L)	Inflow [TN] (mg/L)	Inflow TSS kg/Day	Inflow TP kg/Day	Inflow TN kg/Day	Inflow GP kg/Day
19/11/2015         0.0000218         3.53158808         0.07022264         0.000033/1         0.000018         0.000018         0.000018         0.000018           19/11/2015         0.00005108         3.75454357         0.01257454         0.2356742         0.0256106         0.00040523         3.75153626         0.00040523         0.0534712         0.15726329         0.00040533         0.0534712         0.15726357         0.00040573         0.0534712         0.15726357         0.00040573         0.0314773         0.1492239           13/11/2015         0.0000006         3.5187364         0.05638371         0.00000074         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.0000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.000006         0.0000006         0.000006         0.000006	9/11/2015	0.00145061	30.51922202	0.12743884	1.44281009	3.825065	0.01597229	0.18083169	0.29318867
1)1/17015         0.0007501         27.3460074         0.13919657         1.6955842         0.0008610         0.0001871           1)21/12015         0.0007502         27.3460074         0.13828269         1.4762262         1.2735026         0.00347123         0.031782829           1)31/12015         0.0002577         3.3285354         0.1593187         1.4447222         0.7755026         0.00347123         0.03378269           1)51/12015         0.00002576         3.3285354         0.0593187         1.0487978         0.0000745         0.00000745         0.0000074         0	10/11/2015	0.0000018	3.51158898	0.07062254	0.97049032	0.00005347	0.00000108	0.00001478	0
12/12/103         0.0007502         27.34609474         0.13858600         1.77253220         0.0008307         0.014756         0.23276688           13/12/103         0.00001422         34.7130938         0.14425271         1.77553220         0.00347726         0.03341673         0.4859558           13/12/103         0.00000007         33.2567788         0.14622520         0.00000445         0.00000073         0.0000073         0.0000073         0.0000073         0.0000073         0.0000073         0.0000073         0.0000073         0.0000073         0.0000073         0.0000073         0.0000073         0.0000073         0.0000073         0.0000773         0.00000773         0.00000773         0.00000773         0.00000773         0.00000773         0.00000773         0.00000773         0.00000773         0.00000773         0.00000773         0.00000773         0.00000773         0.00000773         0.00000773         0.00000773         0.00000773         0.0000073<	11/11/2015	0.00052108	37.66421357	0.12574232	1.35196567	1.69568482	0.00566106	0.060867	0.20601871
14/12/1015         0.0004072         34.12309386         0.1472250         1.12736269         0.0084052         0.03841723         0.01728629           15/11/2015         0.0002076         33.2825346         0.1053187         1.04827222         0.77500145         0.0000075         0.03041723         0.04829723           15/11/2015         0.0002077         33.2825346         0.0753788         0.05138877         0.00003588         0.0131773         0.0000078         0.0001388         0.01013773         0.0000078         0.0000077         0.0000077         0.0000077         0.0000077         0.0000077         0.0000077         0.0000077         0.0000077         0.0000077         0.0000078         0.0000070         0.0000077         0.0000077         0.0000077         0.0000077         0.0000070         0.000007         0.000007         0.000007         0.000007         0.000007         0.000007         0.000077         0.0000078         0.0000078         0.000007         0.000000         0.000007         0.000007         0.000007         0.000007         0.000007         0.000007         0.000007         0.000007         0.000007         0.000000         0.000007         0.000007         0.000007         0.000007         0.000007         0.000007         0.000007         0.000007         0.000007 <t< td=""><td>12/11/2015</td><td>0.00075021</td><td>27.34609474</td><td>0.13858809</td><td>1.40619596</td><td>1.77253329</td><td>0.00898307</td><td>0.09114754</td><td>0.23676498</td></t<>	12/11/2015	0.00075021	27.34609474	0.13858809	1.40619596	1.77253329	0.00898307	0.09114754	0.23676498
14/1/2015         0.00026774         33.5383346         0.1503187         1.44457222         0.07560257         0.00347726         0.03841673         0.1485958           15/1/2015         0.00000063         3.2617284         0.0695881         1.071829227         0.0000465         0.0000708         0.0000703         0.0000703         0.00007049         0 <td< td=""><td>13/11/2015</td><td>0.00041923</td><td>34.71309386</td><td>0.14922594</td><td>1.4762262</td><td>1.25736269</td><td>0.0054052</td><td>0.05347123</td><td>0.18728629</td></td<>	13/11/2015	0.00041923	34.71309386	0.14922594	1.4762262	1.25736269	0.0054052	0.05347123	0.18728629
15/11/2015         0.00000006         3.26.17384         0.000293         0.0000035         0.00000475         0           15/11/2015         0.00000073         57.6555919         0.17786989         1.52159488         0.05138877         0.0000508         0.0000791         0           15/11/2015         0.0000071         5.4634829         0.0722386         1.057971         0.0035874         0.0005080         0.000709         0	14/11/2015	0.00026774	33.52853546	0.1503187	1.44457232	0.77560257	0.00347726	0.03341673	0.14859558
18/11/2015         0         9999         9999         0         0         0         0           18/11/2015         0.0000103         57/61555312         0.01752286         1.0357971         0.0036374         0.0000588         0.0007049         0           18/11/2015         0         9999         9999         0	15/11/2015	0.0000006	3.26177384	0.06958331	0.94219252	0.00001645	0.0000035	0.00000475	0
17/1/2015         0.000133         57.61583919         0.17786989         1.5219588         0.03383714         0.0000088         0.0007049         0           18/1/2015         0         -9999         -9999         0<	16/11/2015	0	-9999	-9999	-9999	0	0	0	0
18/11/2015         0.0000771         5.46314829         0.07522386         1.0587971         0.0036374         0.0007080         0.000709           20/11/2015         0         -9999         -9999         9999         0 <td< td=""><td>17/11/2015</td><td>0.00001033</td><td>57.61585919</td><td>0.17786989</td><td>1.52195888</td><td>0.05139877</td><td>0.00015868</td><td>0.00135773</td><td>0</td></td<>	17/11/2015	0.00001033	57.61585919	0.17786989	1.52195888	0.05139877	0.00015868	0.00135773	0
19/1/2015         0         -9999         -9999         9999         0         0         0           21/1/2015         0         -9999         -9999         9999         0         0         0         0           21/1/2015         0         -9999         -9999         9999         0         0         0         0         0           21/1/2015         0         -9999         -9999         -9999         0	18/11/2015	0.00000771	5.46314829	0.07522386	1.0587971	0.00363714	0.00005008	0.0007049	0
20/12/0215         0         -9999         -9999         -9999         -9999         0         0         0         0           21/11/2015         0         -9999         -9999         -9999         -9999         0         0         0         0         0           21/11/2015         0         -9999         -9999         -9999         -9999         0         0         0         0         0         0           21/11/2015         0         -9999         -9999         -9999         0	19/11/2015	0	-9999	-9999	-9999	0	0	0	0
21/11/2015         0         -9999         -9999         9999         0         0         0         0           22/11/2015         0         -9999         -9999         9999         0         0         0         0           23/11/2015         0         -9999         -9999         9999         0         0         0         0           24/11/2015         0         -9999         -9999         -9999         0 <td>20/11/2015</td> <td>0</td> <td>-9999</td> <td>-9999</td> <td>-9999</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td>	20/11/2015	0	-9999	-9999	-9999	0	0	0	0
22/11/2015         0         -9999         -9999         9999         0         0         0         0           23/11/2015         0         9999         9999         9999         0	21/11/2015	0	-9999	-9999	-9999	0	0	0	0
12/12/12015         0         -9999         -9999         -9999         0         0         0         0           25/11/2015         0.00018739         25.549509922         0.14342691         1.48600418         0.41277657         0.00232214         0.02405904         0.1185892           26/11/2015         0         -9999         -9999         -9999         0         0         0         0         0           28/11/2015         0         -9999         -9999         -9999         0	22/11/2015	0	-9999	-9999	-9999	0	0	0	0
24/11/2015         0         -9999         -9999         -9999         0         0         0         0         0           25/11/2015         0         -9999         -9999         -9999         -0         0 <td>23/11/2015</td> <td>0</td> <td>-9999</td> <td>-9999</td> <td>-9999</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td>	23/11/2015	0	-9999	-9999	-9999	0	0	0	0
25/11/2015         0.000232214         0.024205904         0.1185802           26/11/2015         0         -9999         9999         0         0         0         0           27/11/2015         0         -9999         -9999         -9999         0	24/11/2015	0	-9999	-9999	-9999	0	0	0	0
is/1/1/2015         0         -9999         -9999         0         0         0         0         0           28/11/2015         0         -9999         -9999         0	25/11/2015	0.00018739	25.49509922	0.14342691	1.48600418	0.41277657	0.00232214	0.02405904	0.1185892
27/11/2015         0         -9999         -9999         -9999         0         0         0         0           28/11/2015         0         -9999         -9999         -9999         0         0         0         0         0           29/11/2015         0.00025523         33.55818073         0.14673732         1.37237548         0.0021634         0.0024634         0.00249149         0.15913845           1/12/2015         0         -9999         -9999         -9999         0	26/11/2015	0	-9999	-9999	-9999	0	0	0	0
28/11/2015         0         -9999         -9999         0         0         0         0           30/11/2015         0         -9999         9999         0         0         0         0           30/11/2015         0.000025252         33.55818073         0.14673732         1.37237914         0.73215833         0.00220145         0.00294199         0.15913845           1/12/2015         0         -9999         9999         0	27/11/2015	0	-9999	-9999	-9999	0	0	0	0
29/11/2015         0         -9999         -9999         0         0         0         0         0           20/11/2015         0.0002522         33.55818073         0.14673721         1.72215833         0.00320145         0.02934199         0.15913845           1/12/2015         0         9.9999         -9999         0         0         0         0         0           2/12/2015         0         -9999         -9999         -9999         0         <	28/11/2015	0	-9999	-9999	-9999	0	0	0	0
30/11/2015         0.00025252         33.55818073         0.14673732         1.37237914         0.73215833         0.0032045         0.02994199         0.15913845           1/12/2015         0         0.9999         -9999         0         0         0         0         0           3/12/2015         0         -9999         -9999         0	29/11/2015	0	-9999	-9999	-9999	0	0	0	0
1/12/2015         0.000049         4.88425408         0.07471571         1.03777848         0.02072157         0.00031634         0.00439381         0           2/12/2015         0         -9999         -9999         -9999         0	30/11/2015	0.00025252	33.55818073	0.14673732	1.37237914	0.73215833	0.00320145	0.02994199	0.15913845
2/12/2015         0         -9999         -9999         -9999         0         0         0         0           3/12/2015         0         -9999         -9999         -9999         0         0         0         0           4/12/2015         0         -9999         -9999         -9999         0         0         0         0           5/12/2015         0.00028891         32.75291626         0.13870976         1.41441707         0.81757542         0.0000433         0.00000439         0           7/12/2015         0.0001823         31.4337018         0.1226695         1.26615708         0.37542171         0.0122627         0.1161572         0.26033409           8/12/2015         0         0.9999         -9999         0         0         0         0         0           10/12/2015         0         -9999         -9999         0	1/12/2015	0.000049	4.89425408	0.07471571	1.03777848	0.02072157	0.00031634	0.00439381	0
3/12/2015         0         -9999         -9999         -9999         0         0         0         0           4/12/2015         0         -9999         -9999         0         0         0         0         0           5/12/2015         0.00026891         32.75291626         0.13870976         1.41441707         0.81757542         0.00346246         0.03530655         0.15566653           6/12/2015         0.0000006         2.67568771         0.06832573         0.91944349         0.00001278         0.0002033         0.00000339         0           7/12/2015         0.00013823         31.4337018         0.12506995         1.26615708         0.37542171         0.0102427         0.11512208         0.08031467           9/12/2015         0         0.9999         -9999         0	2/12/2015	0	-9999	-9999	-9999	0	0	0	0
4/12/2015         0         -9999         -9999         0         0         0         0         0           5/12/2015         0.00028891         32.75291626         0.13870976         1.41441707         0.81757542         0.00046246         0.03530655         0.1556663           6/12/2015         0.0000006         2.67568771         0.06822573         0.91944394         0.0001278         0.0000033         0.00000439         0           7/12/2015         0.00001823         31.4337018         0.12566995         1.26615708         0.37542171         0.00149375         0.01512208         0.00801467           9/12/2015         0.0000001         2.58683508         0.06885344         0.92597758         0.00000197         0.00000007         0           10/12/2015         0         -9999         -9999         0         0         0         0         0           11/12/2015         0         -9999         -9999         0	3/12/2015	0	-9999	-9999	-9999	0	0	0	0
5/12/2015         0.00028891         32.75291626         0.13870976         1.41441707         0.81757542         0.00346246         0.03330655         0.15566663           6/12/2015         0.00000006         2.67568771         0.06832573         0.91944394         0.00001278         0.0000033         0.00000439         0           9/12/2015         0.000014921         30.80094177         0.12462695         1.4156089         2.52737267         0.01022627         0.01512208         0.08031467           9/12/2015         0.00000001         2.5883508         0.0688334         0.9259778         0.00000178         0.0000005         0.0000007         0           10/12/2015         0         -9999         -9999         -9999         0	4/12/2015	0	-9999	-9999	-9999	0	0	0	0
6/12/2015         0.0000006         2.67588771         0.06832573         0.09439434         0.00001278         0.0000033         0.00000439         0           7/12/2015         0.00094971         30.80094177         0.12462695         1.41560089         2.52737267         0.0122627         0.1161572         0.26033409           9/12/2015         0.0000001         2.58683508         0.06885394         0.92597758         0.00000197         0.00000005         0.0000007         0           10/12/2015         0         -9999         -9999         -9999         0         0         0         0         0         0           11/12/2015         0         -9999         -9999         -9999         0         <	5/12/2015	0.00028891	32.75291626	0.13870976	1.41441707	0.81757542	0.00346246	0.03530655	0.15566663
7/12/2015         0.00094971         30.8094177         0.12462695         1.4150089         2.52737267         0.01022627         0.1161572         0.26033409           8/12/2015         0.00013823         31.4337018         0.12506995         1.26615708         0.37542171         0.00149375         0.01012208         0.000077         0           9/12/2015         0         0.9999         -9999         -9999         0 </td <td>6/12/2015</td> <td>0.0000006</td> <td>2.67568771</td> <td>0.06832573</td> <td>0.91944394</td> <td>0.00001278</td> <td>0.0000033</td> <td>0.00000439</td> <td>0</td>	6/12/2015	0.0000006	2.67568771	0.06832573	0.91944394	0.00001278	0.0000033	0.00000439	0
8/12/2015         0.00013823         31.4337018         0.12566995         1.26615708         0.37542171         0.00149375         0.0000007         0           9/12/2015         0.0000001         2.58683508         0.06885394         0.95997758         0.0000017         0.00000005         0.0000007         0 <td>7/12/2015</td> <td>0.00094971</td> <td>30.80094177</td> <td>0.12462695</td> <td>1.41560089</td> <td>2.52737267</td> <td>0.01022627</td> <td>0.1161572</td> <td>0.26033409</td>	7/12/2015	0.00094971	30.80094177	0.12462695	1.41560089	2.52737267	0.01022627	0.1161572	0.26033409
9/12/2015         0.0000001         2.58683508         0.06885394         0.92597758         0.00000197         0.00000005         0.0000007         0           10/12/2015         0         -9999         -9999         -9999         0         0         0         0         0           12/12/2015         0         -9999         -9999         -9999         0	8/12/2015	0.00013823	31.4337018	0.12506995	1.26615708	0.37542171	0.00149375	0.01512208	0.08031467
10/12/2015       0       -9999       -9999       -9999       0       0       0       0         11/12/2015       0       -9999       -9999       9999       0       0       0       0         12/12/2015       0       -9999       -9999       9999       0       0       0       0       0         13/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         14/12/2015       0       -9999       -9999       -9999       0       0       0       0       0       0         16/12/2015       0.00001632       42.71950385       0.13053355       1.42740566       0.06025062       0.0018417       0.00201318       0       0         16/12/2015       0.00001637       4.33626379       0.07368652       1.02032026       0.00058898       0.00001001       0.00013859       0       0         18/12/2015       0.00076406       25.32404774       0.12554693       1.52462881       1.67177173       0.008288       0.10064865       0.24024588         19/12/2015       0       -9999       -9999       0       0       0       0       0       0       0       0	9/12/2015	0.0000001	2.58683508	0.06885394	0.92597758	0.00000197	0.0000005	0.000007	0
11/12/2015       0       -9999       -9999       -9999       0       0       0       0         12/12/2015       0       -9999       -9999       -9999       0       0       0       0         13/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         14/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         15/12/2015       0       -9999       -9999       -9999       0       0       0       0       0       0         16/12/2015       0.0000152       4.33626379       0.07368652       1.02032026       0.0005898       0.0001001       0.0013859       0       0         18/12/2015       0.00076406       25.32404774       0.12554693       1.52462881       1.67177173       0.008288       0.0003433       0       0         20/12/2015       0       0.9999       -9999       -9999       0       0       0       0       0       0       0         21/12/2015       0       -9999       -9999       -9999       0       0       0       0       0       0       0	10/12/2015	0	-9999	-9999	-9999	0	0	0	0
12/12/2015       0       -9999       -9999       -9999       0       0       0       0         13/12/2015       0       -9999       -9999       -9999       0       0       0       0         14/12/2015       0       -9999       -9999       -9999       0       0       0       0         15/12/2015       0       -9999       -9999       -9999       0       0       0       0         16/12/2015       0.00001632       42.71950385       0.13058365       1.42740566       0.06025062       0.00018417       0.00201318       0         17/12/2015       0.000076406       25.32404774       0.12554693       1.52462881       1.67177173       0.008288       0.10064865       0.24024588         19/12/2015       0.00000042       2.92509701       0.06911542       0.94316428       0.0001648       0.00000252       0.00003433       0         20/12/2015       0       -9999       -9999       0       0       0       0       0         22/12/2015       0       -9999       -9999       0       0       0       0       0         23/12/2015       0       -9999       -9999       -9999       0       0	11/12/2015	0	-9999	-9999	-9999	0	0	0	0
13/12/2015       0      9999      9999      9999       0       0       0       0         14/12/2015       0       -9999       -9999       -9999       0       0       0       0         15/12/2015       0       -9999       -9999       -9999       0       0       0       0         16/12/2015       0.00001632       42.71950385       0.13058365       1.42740566       0.06025062       0.00018417       0.00201318       0         17/12/2015       0.00001677       4.33626379       0.07368652       1.02032026       0.00058898       0.00001001       0.00013859       0         18/12/2015       0.00076406       25.32404774       0.12554693       1.52462881       1.67177173       0.008288       0.10064865       0.24024588         19/12/2015       0       0.9999       -9999       0       0       0       0       0         20/12/2015       0       -9999       -9999       0       0       0       0       0       0         22/12/2015       0       -9999       -9999       0       0       0       0       0       0       0         22/12/2015       0       -9999       -9999 <td>12/12/2015</td> <td>0</td> <td>-9999</td> <td>-9999</td> <td>-9999</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td>	12/12/2015	0	-9999	-9999	-9999	0	0	0	0
14/12/2015       0      9999      9999       0       0       0       0         15/12/2015       0       0.9999      9999       0       0       0       0         16/12/2015       0.00001632       42.71950385       0.13058365       1.4274056       0.06025062       0.00018417       0.00201318       0         17/12/2015       0.0000157       4.33626379       0.07368652       1.02032026       0.00058898       0.0001001       0.00013859       0         18/12/2015       0.00076406       25.32404774       0.12554693       1.52462881       1.67177173       0.008288       0.10064865       0.24024588         19/12/2015       0.00000042       2.92509701       0.06911542       0.94316428       0.00010648       0.00000252       0.0003433       0         20/12/2015       0      9999      9999      9999       0       0       0       0         21/12/2015       0      9999      9999      9999       0       0       0       0       0         22/12/2015       0      9999      9999      9999       0       0       0       0       0         25/12/2015       0      9999 <td< td=""><td>13/12/2015</td><td>0</td><td>-9999</td><td>-9999</td><td>-9999</td><td>0</td><td>0</td><td>0</td><td>0</td></td<>	13/12/2015	0	-9999	-9999	-9999	0	0	0	0
15/12/2015       0       0       0       0       0       0       0       0       0         16/12/2015       0.0001632       42.71950385       0.13058365       1.42740566       0.06025062       0.00018417       0.00201318       0         17/12/2015       0.00001632       43.3626379       0.07368652       1.02032026       0.00058898       0.0000101       0.00015359       0         18/12/2015       0.00076406       25.32404774       0.12554693       1.52462881       1.67177173       0.008288       0.10064865       0.24024588         19/12/2015       0.0000042       2.92509701       0.06911542       0.94316428       0.00010648       0.00000252       0.00003433       0         20/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         21/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         22/12/2015       0       -9999       -9999       -9999       0       0       0       0         24/12/2015       0       -9999       -9999       -9999       0       0       0       0       0       0	14/12/2015	0	-9999	-9999	-9999	0	0	0	0
16/12/2015         0.00001632         42.71950385         0.13058365         1.42740566         0.06025062         0.00018417         0.00211318         0           17/12/2015         0.0000157         4.33626379         0.07368652         1.02032026         0.0005898         0.00001001         0.00013859         0           18/12/2015         0.00076406         25.32404774         0.12554693         1.52462881         1.67177173         0.008288         0.10064865         0.24024588           19/12/2015         0.0000042         2.92509701         0.06511542         0.94316428         0.00010648         0.00000252         0.00003433         0           20/12/2015         0         -9999         -9999         -9999         0         0         0         0         0           21/12/2015         0         -9999         -9999         -9999         0	15/12/2015	0	-9999	-9999	-9999	0 00005000	0	0	0
17/2/2015       0.0000157       4.33626379       0.0738852       1.02032026       0.00008898       0.0001101       0.00013859       0         18/12/2015       0.00076406       25.32404774       0.12554693       1.52462881       1.67177173       0.008288       0.10064865       0.24024588         19/12/2015       0.0000042       2.92509701       0.06911542       0.94316428       0.00010648       0.00000252       0.00003433       0         20/12/2015       0       -9999       -9999       0       0       0       0       0         21/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         22/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         24/12/2015       0       -9999       -9999       -9999       0       0       0       0       0       0         25/12/2015       0       -9999       -9999       -9999       0 <t< td=""><td>16/12/2015</td><td>0.00001632</td><td>42.71950385</td><td>0.13058365</td><td>1.42740566</td><td>0.06025062</td><td>0.00018417</td><td>0.00201318</td><td>0</td></t<>	16/12/2015	0.00001632	42.71950385	0.13058365	1.42740566	0.06025062	0.00018417	0.00201318	0
16/12/2015       0.00070400       25.52404774       0.12534055       1.52402861       1.07177175       0.0002285       0.10084865       0.24024588         19/12/2015       0.00000042       2.92509701       0.06911542       0.94316428       0.00010648       0.00000252       0.00003433       0         20/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         21/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         22/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         23/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         24/12/2015       0       -9999       -9999       -9999       0	18/12/2015	0.00000157	4.33020379	0.0/368652	1.02032026		0.00001001	0.00013859	0 24024599
1/12/2015       0.0000042       2.32305701       0.0001342       0.34310420       0.00010446       0.0000022       0.000004252       0.00004453       0.0000042       0.0000042       0.0000042       0.0000042       0.0000042       0.0000042       0.000004       0.0000000       0.0000000       0.0000000       0.0000000       0.0000000       0.0000000       0.00000000       0.00000007       0.0000	10/12/2015	0.00076406	23.32404774	0.12004093	0.04216420	0.00010649		0.10004605	0.24024588
2/12/2015       0       -5555       -5555       0       0       0       0       0         21/12/2015       0       -9999       -9999       -9999       0       0       0       0         22/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         23/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         24/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         25/12/2015       0       -9999       -9999       -9999       0       0       0       0       0       0         26/12/2015       0.00015359       25.77535325       0.1245256       1.33175558       0.34204288       0.00165247       0.0176726       0.1018116         27/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         28/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         30/12/2015       0       -9999       -9999       -9999	20/12/2015	0.0000042	2.92509701	0.00911342	_0000	0.00010048	0.00000232	0.00003433	0
21/12/2013       0       -5355       -5355       0       0       0       0       0         22/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         23/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         24/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         25/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         26/12/2015       0.00015359       25.77535325       0.1245256       1.33175558       0.34204288       0.00165247       0.0176726       0.10181116         27/12/2015       0.0000001       2.42530317       0.06797847       0.920113       0.00000177       0.0000005       0.0000067       0         28/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         29/12/2015       0       -9999       -9999       -9999       0       0       0       0       0         30/12/2015       0       -9999       -9999	20/12/2015	0	-9999	-9999	-9999	0	0	0	0
12/12/2015         0         -5555         -5555         -5555         0	22/12/2015	0		-9999	-9999		0	0	0
25/12/2013       0       0       0       0       0       0       0       0         24/12/2015       0       0       0       0       0       0       0       0       0         25/12/2015       0       0       0       0       0       0       0       0       0       0       0         26/12/2015       0.00015359       25.77535325       0.1245256       1.33175558       0.34204288       0.00165247       0.0176726       0.10181116         27/12/2015       0.00000001       2.42530317       0.06797847       0.920113       0.00000177       0.00000005       0.00000067       0         28/12/2015       0       0       9999       -9999       9999       0       0       0       0       0         29/12/2015       0       0       9999       -9999       0	22/12/2015	0	-9999		-9999	0	0	0	0
2+7/12/2015         0 <th< td=""><td>23/12/2013</td><td>0</td><td>-9999</td><td>0000_</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></th<>	23/12/2013	0	-9999	0000_	0	0	0	0	0
26/12/2015         0.00015359         25.77535325         0.1245256         1.33175558         0.34204288         0.00165247         0.0176726         0.10181116           27/12/2015         0.00000001         2.42530317         0.06797847         0.920113         0.00000177         0.00000005         0.00000067         0           28/12/2015         0         -9999         -9999         -9999         0         0         0         0         0           29/12/2015         0         -9999         -9999         -9999         0	25/12/2015	0	_9999	<u>وووو</u> ۔ مومور			0	0	0
27/12/2015         0.00000001         2.42530317         0.06797847         0.920113         0.00000177         0.00000005         0.00000067         0           28/12/2015         0         -9999         -9999         -9999         0	26/12/2015	0 00015359	25 77535325	 0 1245256	1 33175558	0 34204288	0 00165247	0 0176726	0 10181116
28/12/2015         0         -9999         -9999         -9999         0	27/12/2015	0.00000001	2.42530317	0.06797847	0 920113	0.00000177	0.00000005	0.0000067	0.10101110
29/12/2015         0         -9999         -9999         -9999         0	28/12/2015	0		-9999	_9999	0.000001//	0.0000000	0.0000007	0
30/12/2015         0         -9999         -9999         0	29/12/2015	0	-9999	-9999	-9999	0	0	0	0
	30/12/2015	0	-9999	-9999	-9999	0	0	0	0
31/12/2015  0  -9999  -9999  -9999  0  0  0  0  0 0	31/12/2015	0	-9999	-9999	-9999	0	0	0	0


## Appendix E

Updated Correspondence with North Sydney Council

© Sydney Metro 2020

Page 53 of 53

Sydney Metro City & Southwest | Crows Nest Over Station Development Submission Report -Appendix G: Flood Assessment and Stormwater Management Plan

From:	Jim Moore
To:	Pulith VIDANAPATHIRANA
Cc:	Kane, Ryan Peter; Willem VAN EDE
Subject:	RE: Crows Nest Station - Stormwater drainage clarifications
Date:	Monday, 3 June 2019 2:32:41 PM

Hi Pulith,

Thank you for your email.

Please see below for my response to your questions.

If you need anything further please feel free to ask me.

Kind regards,

Jim Moore Engineering Project Manager P +61 2 9936 8233 E Jim.Moore@northsydney.nsw.gov.au	
www.northsydney.nsw.gov.au	222

From: Pulith VIDANAPATHIRANA <Pulith.Vidanapathirana@smec.com>

Sent: Monday, 27 May 2019 5:02 PM

To: Jim Moore <Jim.Moore@northsydney.nsw.gov.au>

Cc: Kane, Ryan Peter <Ryan.Kane2@transport.nsw.gov.au>; Willem VAN EDE <Willem.vanEde@smec.com>

Subject: RE: Crows Nest Station - Stormwater drainage clarifications

Hi Jim,

Appreciate your time on the phone. Just wanted to summarise our discussion here:

- 1. North Sydney Council's detention system requirements remain the same as for the Stage 1 Metron Design. le the maximum discharge from the site for all storms up to the 1 in 100 year storm, should not exceed the discharge which would occur during a 1 in 5 year storm for the existing site conditions
- 2. The 'Stormwater Drainage Design Guidelines' document referred to in 'Performance Guide for Engineering Design & Construction (July 2005)' is likely to be outdated.
- 3. Council's longitudinal drainage systems are required to be sized for the 1 in 20 year ARI storm.
- 4. NSC will advise any Council requirements in relation to:
  - Council-specific flow width requirements there are no specific requirement however using either Austroads or QUDM manuals would be appropriate
  - Any Council-specific water quality improvement targets The following targets have been used on other developments within the LGA:

80% retention of the typical urban annual load for Total Suspended Solids (TSS) 45% retention of the typical urban annual load for Total Phosphorus (TP) 45% retention of the typical urban annual load for Total Nitrogen (TN) 70% retention of the typical urban annual load for gross pollutants (litter).

 There are some anomalies with ARR2016 data within the North Sydney Council LGA. As such, the design will commence using ARR1987 (which generally delivers more conservative results), with the potential to rationalise the design at a later stage
 DRAINS models preferred for submissions to Council

Look forward to hearing your thoughts on point 4.

Thanks and regards,

Pulith Vidanapathirana Drainage Engineer - Roads and Highways SMEC (Member of the Surbana Jurong Group)

From: Kane, Ryan Peter <<u>Ryan.Kane2@transport.nsw.gov.au</u>>
Sent: Tuesday, 7 May 2019 4:13 PM
To: 'Jim Moore' <<u>Jim.Moore@northsydney.nsw.gov.au</u>>
Subject: RE: Crows Nest Station - Request for docs North Sydney Council

Thank you Jim,

**T** +61 2 9925 5432

Please refer design queries attached, if you could please address each item it'd be greatly appreciated.